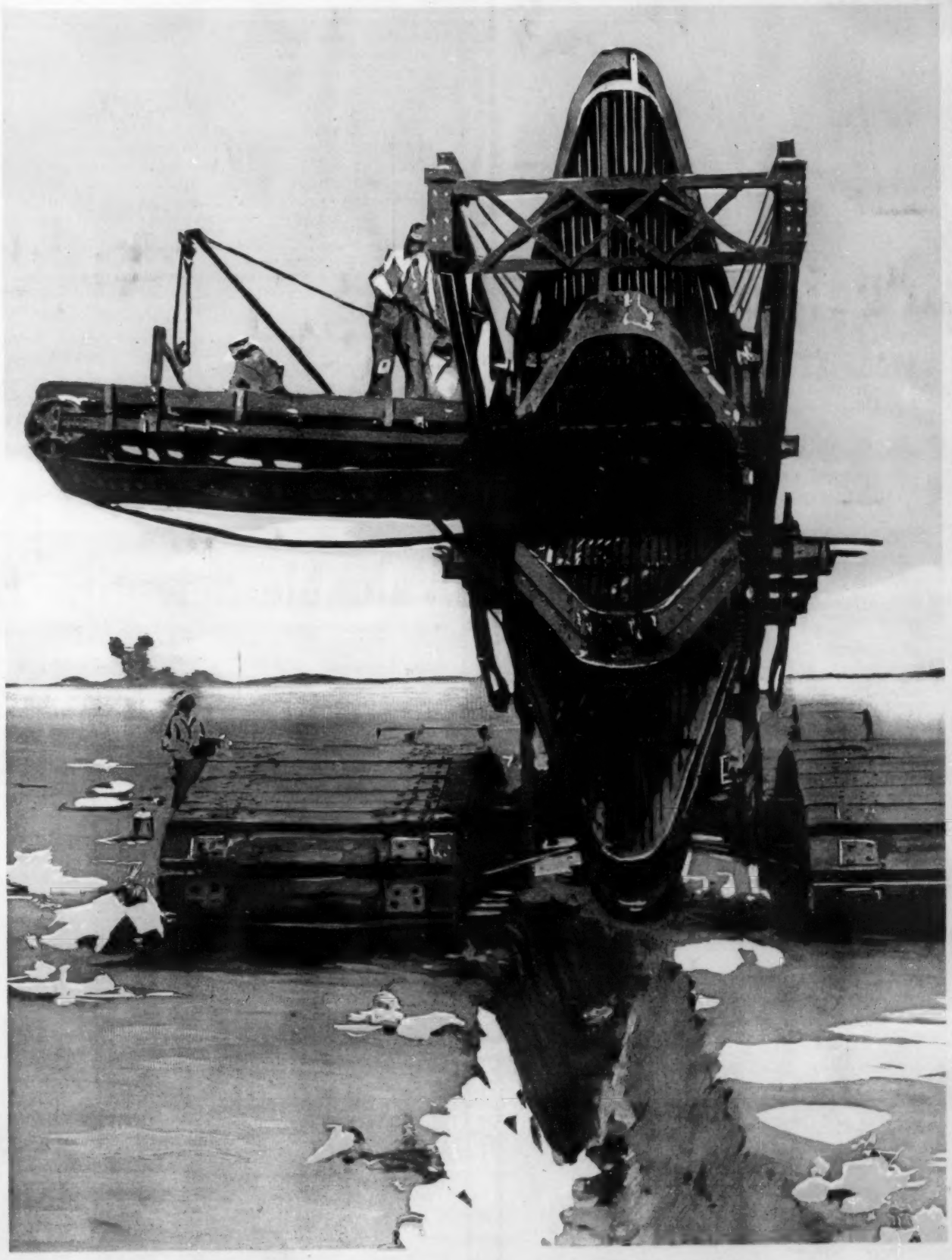
SCIENTIFIC AMERICAN



RECLAIMING WASTE LANDS WITH A GIGANTIC DITCHER.—[See page 258]

September 16, 1916

Munn & Co., Inc., Publishers
New York, N. Y.

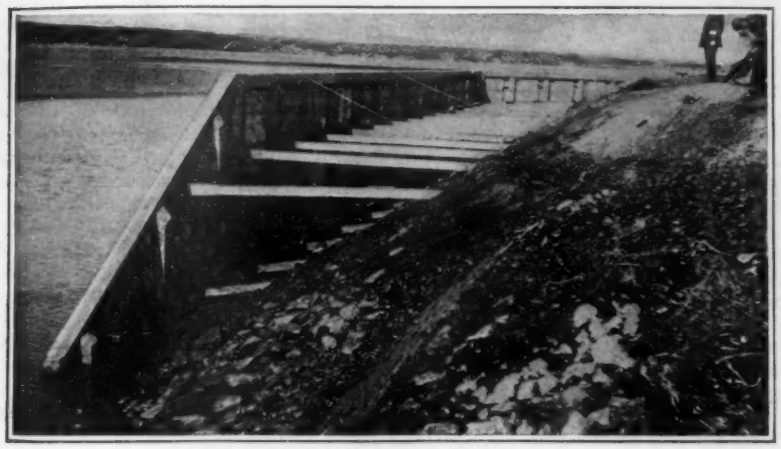
Price 10 Cents

SEVENTY-SECOND YEAR

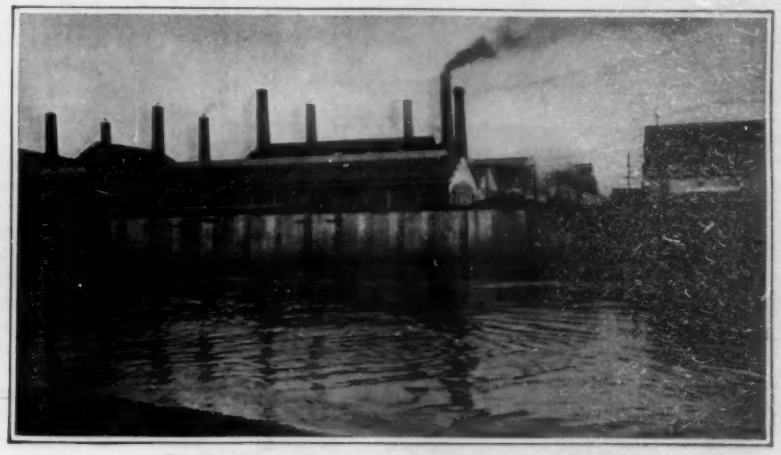
SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXV. NUMBER 12] NEW YORK, SEPTEMBER 16, 1916 [10 CENTS A COPY $3.00 A YEAR



Filling behind a wall of concrete sheet piles



Recessed water-front wall of concrete sheet piles

Concrete Sheet Piles

A New Departure in Waterfront Construction

AT Dines sur Mer, a little seaport town of France, there is under way a terminal project embodying an unusual form of reinforced concrete construction. The use of concrete in place of wood for the ordinary circular pile in docks, causeways and bridges is an old story; but the method employed in laying down the piers, jetties, sea-walls, etc., in the present instance involves the extensive use of concrete in the form of sheet piles. The principle distinctive feature of this system, designed by Messrs. Coignet and Coiseau and already employed to a less extent at Mureaux and at Ivry sur Seine, near Paris, consists in fitting the main piles, which are set in rectangular section, with wings forming sheet piles for a certain portion of the height, with the foot of the main pile protruding at the bottom to facilitate the work of driving.

These piles are driven at a fixed distance from each other either with the wings of one pile adjoining those of the next, or with an interval to be filled up by smaller or secondary sheet piles. It is not necessary that the sheet piles be driven to a very hard set. It is then comparatively easy to regulate the driving of the piles so as to bring all the heads to the same level.

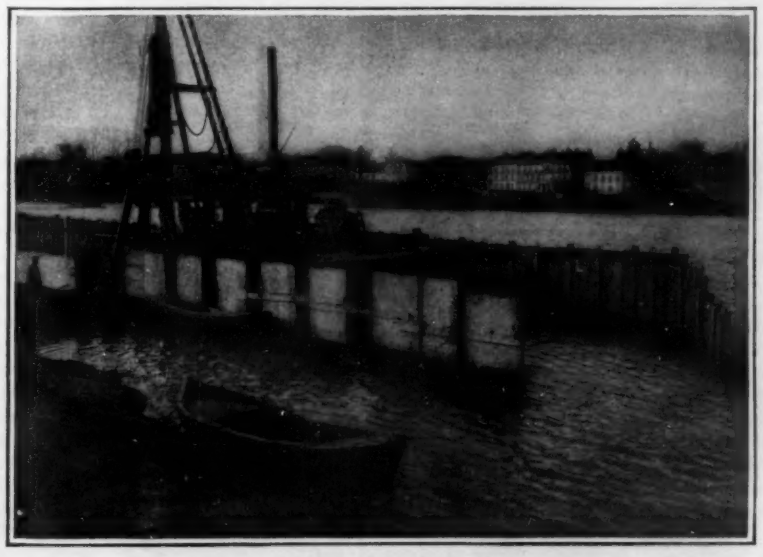
The section of the main piles and the steel reinforcement of these is calculated to be of sufficient strength to resist the flexions produced by the horizontal pressure. These sheet piles have usually a width of three to five feet, and a thickness varying from three to eight inches. The lower portions of both piles and wings are fitted with steel shoes.

The principal and secondary piles are driven into the ground sufficiently to prevent any undermining from taking place below the wings and panels. In good ground it is possible to reduce the penetration of these to a few inches; in bad ground, however, it is necessary to drive to a considerable depth. In any event, it is claimed that all washing away may be prevented by filling up with a certain amount of hard core on both sides of the sheet piles before putting in the earth in the rear of the quay.

In the constructions at Dives and at Mureaux the intermediate sheet piles are placed behind the principal ones. This gives an architectural effect of a series of recesses and abutments, and is in many cases to be preferred to the plain unbroken wall. The latter may, however, be obtained readily enough. The principal sheet piles are usually tied back by means of steel bars cased in concrete, which are hooked to a reinforced concrete anchor plate pressing against the ground and placed in a vertical position at a sufficient distance to prevent any possible movement.

After filling has been completed at the back of the curtain wall formed by the sheet piles, if it is desired to prevent the washing away of the filling through the interstices, it is possible to stop up these by means of injections of cement grout. This is done through a tube stuck into the ground to the required depth behind the wall, this tube being gradually withdrawn as the process continues. In general, however, it is found advantageous to leave a small opening between successive piles in order to diminish the danger of accumulation of water behind the curtain. This is especially the case in tidal waters. Here it is necessary to use filling materials that will not readily be washed away between the joints of the sheet piles.

Among the explicit advantages of this type of construction are the very considerable decrease in the thickness of wall necessary to support a given resistance, and the economy of construction in the arrangement of the reinforcing steel framework. The latter consists, in the wings, merely of a meshwork of round bars, and in the main piles of such a meshwork tied together with stirrups.



Driving concrete sheet piles

Growth of Canada's Water and Sewerage Systems

THE very great development of the waterworks systems in Canada is represented by an increase in number of plants from 7 in 1867 to 528 in 1916. These have been built at a total cost of $123,725,633, and entail an annual maintenance charge of $4,558,539. There are 206 plants supplied from springs or wells, and 322 from lakes or streams. In 72 of them the water is filtered and in 21 it is treated with hypochlorite. The municipality owned plants number 396. Flat rates are offered in 209 cases.

There are 279 sewerage systems in Canada, having an aggregate mileage of 4,223. They were built at a total cost of $75,504,418. In only 75 municipalities is the sewerage treated. Proportionately to population, the West, with 28 treatment plants, makes a much better showing than the East with 47. The total cost of the treatment plants is $3,218,935.

Early Revival of the South African Diamond Industry

THERE are strong indications of an early, if but partial, revival of the South African diamond industry, which has been closed down since the beginning of the war, as a result of drastic action taken for the purpose of preserving the diamond market by restricting the output of stones. Closing of the diamond mines affected South Africa from an industrial and economic point of view more seriously than anything else. In fact, with the exception of diamond mining, the country's industrial operations have not suffered to any appreciable extent as a direct result of the war. The gold mining industry of the Transvaal has actually made greater progress under the lash of Mars than ever before, and the working of those mines has been stimulated by the abundance of native labor. Increased activity has also been shown in other branches of mining, so that there has been an expansion of production.

The loss occasioned by the suspension of the diamond industry in 1914 is shown by comparing recent figures with those of production in 1913, when the mines were in full operation. During that year the yield of diamonds in South Africa amounted to 5,163,547 carats, with a value of $55,428,495. During 1915, practically all of the diamonds produced in the Transvaal were from the Kierksdorp-Bloemhof alluvial fields, the production amounting to only 5,674 carats, of a value of $623,238. The combined output of the Transvaal and Orange Free State for 1913, which presented a full year of diamond mining production, was 2,698,654 carats, valued at $21,433,852.

The directors of the Premier mine, near Pretoria, recently decided on a small revival of operations, and since January 1st, 1916, certain work has been in progress. It is understood the operations of mining and washing began in August, the operations being limited to about 25 per cent of the normal working.

Although the price of diamonds has been maintained through the coöperation of the big producers in limiting the output, the market is much restricted. America continues to be the principal market for diamonds, while the cutting industry is still mainly centered at Amsterdam.

SCIENTIFIC AMERICAN

Founded 1845

Published by Munn & Co., Inc., 233 Broadway, New York, Saturday, September 16, 1916

Charles Allen Munn, President, Frederick C. Beach, Secretary, Orson D. Munn, Treasurer, all at 233 Broadway

Entered at the Post Office of New York, N. Y., as Second Class Matter
Entered as Second Class Matter at the Post Office Department, Canada
Trade Mark Registered in the United States Patent Office

The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

The National Research Council

LAST June, in commenting on the Newlands bill for the establishment of engineering experiment stations, we expressed satisfaction that, under the powerful stimulus of recent events, the leading governments of the world, including our own, had at last divested themselves of their whilom antipathy to the word "research." The thaumaturgy of the great war is in no way more strikingly evinced than in the creation of various *official* bodies for the sake of promoting the acquisition of knowledge rather than its application. Officialdom finally realizes that it is impossible to raise crops without first sowing the seed. Adversity is a rough but efficient schoolmaster, and the chastisement that humanity is now undergoing has already driven home some priceless lessons.

The catchword "preparedness," which originally meant a state of readiness for a problematical war, has, of late, come to be applied to an ideal state of national efficiency, not in reference to any particular future event, but to the whole future history of our country. The expression was obviously used in this broader sense by the National Academy of Sciences when, last April, it voted unanimously to offer its services to the President of the United States "in the interest of national preparedness." The offer met with a hearty response in official quarters, and set on foot a train of events that are pregnant with possibilities.

After a conference at the White House with President Wilson, the Academy appointed an organizing committee, headed by Professor George E. Hale, which has now formulated plans for a National Research Council. "It was recognized from the outset," says Professor Hale, in tracing the evolution of this idea, "that the activities of the committee should not be confined to the promotion of researches bearing directly upon military problems, but that true preparedness would best result from the encouragement of every form of investigation, whether for military and industrial application, or for the advancement of knowledge *without regard to its immediate practical bearing.*" The italics are ours.

For the furtherance of this—from the point of view of penny-wise politicians—audacious project, the committee recommended "that there be formed a National Research Council, whose purpose shall be to bring into coöperation existing governmental, educational, industrial and other research organizations with the object of encouraging the investigation of natural phenomena, the increased use of scientific research in the development of American industries, the employment of scientific methods in strengthening the national defense, and such other applications of science as will promote the national security and welfare." Especially significant is the proposal to include in the membership of this council "leading American investigators and engineers, representing the Army, Navy, Smithsonian Institution, and various scientific bureaus of the government; educational institutions and research endowments; and the research divisions of industrial and manufacturing establishments." The members are to be chosen in consultation with the presidents of the leading national scientific, academic and technical societies, while the cabinet officers are to be asked to name the representatives of government scientific bureaus under their supervision.

These proposals were accepted by the National Academy, which authorized its committee to proceed with the organization of the projected council. Its membership is now nearly complete. Under date of July 24, the President of the United States also expressed his approval of the plan, and announced that the departments of the government had been instructed to coöperate. Lastly, scientific societies, universities and industrial concerns have universally welcomed the scheme and indicated their eagerness to participate. Thus for the first time in the history of this country science, education, industry and the federal government have joined hands in a plan for the promotion of research, as such, without stipulations or preoccupations as to immediate "practical" returns.

Modern Artillery and Individual Initiative

IT is an interesting lesson that can be drawn from a comparison of the great battles of Verdun and Picardy—a lesson that seems to have been quite overlooked by military experts and critics in their efforts to direct attention to what they have considered the more important phases of the two struggles. This lesson is to be found in the crucial test of the soldier trained by rigid discipline to rely on the leadership of his superiors absolutely, and that of the soldier who, while relying on the higher command under normal circumstances, has not been subjugated to a point where he is no longer able to act for himself should the occasion arise so to do.

At Verdun, it will be recalled, the fire of the German heavy artillery was so intense that the trenches of the French defenders were soon swept away. Communication trenches, lookout posts, and telegraph and telephone wires too were utterly destroyed in the face of the overwhelming avalanche of steel and high explosive. From the stories of survivors who fought in the advanced trenches it is learned that the French troops were literally blasted out or buried in their trenches; and those who were not killed or buried by the artillery preparation were broken up into scattered, disconnected bands, often without officers and more often without any means whatsoever of communication with the directing genius of the army somewhere back of Verdun.

What did the men do? With not only every shred of military organization swept away in a torrent of fire, but the revictualing and supply services seriously impaired, the French before Verdun were left absolutely on their own resources. The little groups of soldiers had to be their own general staff. After each bombardment it remained for those who survived to drag out their machine guns from among the debris of the trenches and install them in the huge craters made by the shell fire. The scattered bands maneuvered about, each following out its own tactical plan in order to inflict the greatest losses possible on the masses of German infantry that swept forward after the artillery preparation. Prepared positions were out of the question for the French during the first weeks of the combat; improvisation, initiative, and individuality read the order of the day.

The battle of the Somme presents some features that bear comparison with those at Verdun. Chief of these is the overwhelming fire from the guns of the Allies, which is reported to be effacing all semblance of organized enemy positions whenever it prepares the ground for a fresh assault. Driven out of their wrecked defenses, which represent almost two years of diligent, painstaking labor and the highest degree of military science, the Germans have had to do precisely what the French did at Verdun. After each intense artillery preparation by Allied gunners, the surviving Teutons have come out of their deep dugouts and underground works, dragging their machine guns to some advantageous if not previously-planned point whence they can direct streams of lead against the advancing enemy troops.

The battle of the Somme is still being fought. The Allies are still far off from the victory which they seek. But the one point that stands out above all others to an impartial observer is that the Allies have succeeded in breaking down several tiers of what were probably the strongest field works ever constructed by the greatest master-builders of military defenses. The British and French have also captured, after the most stubborn resistance on the part of the defenders, some thirty villages, each fortified to the utmost extent. Why this success?

It will be recalled that both the English and French have used large numbers of patrols, consisting of a few men each, for conducting raids on the wrecked German positions. Even the assaults, we are told, have been carried out by comparatively fewer men than usual, in open formation by way of sharp contrast to the mass attacks of the Anglo-French Champagne offensive of September, 1915, and the more recent offensive of the Germans at Verdun. The result has been that the German machine gunners have failed to exact the toll in enemy lives that was expected of them. We do not deny that they accounted for many lives, but the fact remains that the realization did not come up to expectations.

In a sort of refined guerrilla warfare—brought about by the deadliness of machine guns on massed troops—the Allies have scored important successes, supported of course by an artillery fire of a volume without precedent; for the Allied soldiers, now on the offensive, again broke up into small patrols, even to single individuals, to which work the men seem very well adapted. Each group has had to conduct its own campaign, being separated absolutely from the higher command, and because of their bold tactics these groups or patrols have brought about the complete demoralization of little groups of German defenders badly broken up by the artillery preparation. It is a case of individual against individual, and war without machinery; and the *communiqués* tell us that the Allied patrols won. The Germans, with all due praise for their wonderful discipline and unparalleled military organization, do not appear to be adapted for individual fighting; at least not if the Somme battle is to be taken as a criterion. It is true that some German defenders, in small groups, fought valiantly to the last man among the ruins of villages, but they did not show the dash and strategy and tactics of the small bands of French soldiers making the most of an almost impossible situation on the slopes of the Meuse hills.

Intense artillery fire developed only since the opening of the present year—a fire that sweeps away organized defenses of all kinds and splits up the defenders into numerous small and disconnected groups—makes it imperative that each soldier possess sufficient initiative to act as a military unit when the occasion arises. Discipline is still the big factor, but it must be a form of discipline that does not quench the initiative qualities to be found in almost all men.

The Effect of War Upon National Vitality

AT the outbreak of the present war and for some months thereafter discussion ran high as to what the effect of sending so many men to battle would be upon the civic population of the countries at war. We are indebted to an Englishman, Mr. J. W. Nixon, for a timely treatise on this subject which must allay our fears in certain directions but which, on the other hand, cannot but bring to our attention most forcibly the serious upheaval which, entirely aside from the loss of men engaged in battle, war indirectly produces upon the vitality of a nation. Mr. Nixon has studied all available records of births, deaths and marriages in France and Prussia collected during the war of 1870-71 as well as what vital statistics have been published for the countries engaged in the present war.

The chief effect of the Franco-Prussian War on the civic populations of the two countries was to raise the death rate. In France there was a rapid increase in mortality, chiefly among the infants. In 1871, in the Department of the Seine, death took over one third of the children who were born. Prussia, on the other hand, showed no appreciable rise in the mortality rate until 1872. It is of interest to compare the cause of the rise in the two countries. France was the invaded country and the consequent suffering and privation of her people was indicated in the high death rate. The increased mortality in Prussia in 1872, however, was in part due to an epidemic of small-pox.

Nearby neutral countries also showed the effect of the Franco-Prussian War in their increased death rate.

Although the infant mortality records are not published for all countries engaged in the present European conflict yet those that are furnish illuminating facts. In Paris the death rate among infants increased somewhat from 1914 to 1915. In Berlin there was a decline for the same period. The *Berliner Tageblatt* published in February, 1916, the Prussian mortality records for the past four years among infants less than six months old. It is well to have these brought to our notice in view of the alarming reports in our papers some time since on starvation and death among infants in Germany. In December, 1912, for every 1,000 births there were 206 deaths among infants. Since that time there has been a gradual decrease until in December, 1915, there were not quite half as many deaths among infants as there were in 1912.

While the chief effect of the Franco-Prussian War was to increase the death rate, the present war has affected the birth rate to an alarming degree. In January, 1916, the population of Berlin (based upon the birth statistics) was declining by 300 a week on the average. In England the birth rate is lower during the present strenuous times than it has ever been before.

Mr. Nixon settles definitely the old theory concerning the increase in male over female births during war times. Neither the records for the Franco-Prussian War nor those that are obtainable for the present war show any tendency for the proportion of male to female births to increase above the normal rate. If the statistics for the year following England's war in the Crimea in 1857 and again after the Boer War are considered there would seem at first sight to be some truth in the theory. The excess of male to female births was considerably above that of the preceding and succeeding years in both cases. But in 1884-87, in 1906 and 1909 there was an equally high rise in the number of male births as compared with female births and these years were periods of peace.

Electricity

A Light-Weight Electric Flatiron. — An American manufacturer has introduced a light-weight electric iron for use in laundering small pieces, such as delicate laces, infant's clothing and handkerchiefs, where the conventional six-pound flatiron is too heavy. The new light-weight iron has a current consumption of only 90 watts, and its light weight makes it especially suitable for travelers.

Attachment Plug with Flexible Handle.—Among recent electrical novelties is an attachment plug provided with a five-inch flexible extension. The object of the flexible extension is to bring fixture sockets within easy reach, and permit the plug being used with shades of small diameter. At the same time the flexible plug, being much the same in construction as the usual armored cable, saves the cord at the point of greatest wear and prevents subsequent short circuits.

Power Line Poles in South Africa. — Speaking before the South African Institute of Electrical Engineers with reference to the electrical plant on a Swaziland tin mine, Mr. W. Elsdon-Dew said that no trouble had been experienced from attacks by white ants on the power line poles when these had been creosoted, and if paraffin were periodically introduced into a hole bored into the wood near the base of the pole. But blue-gum or eucalyptus poles cut from trees that had been growing less than five years have a very short life through dry rot setting in. Black wattle of more than five years' growth would now be used, and much better results were expected.

Switchboards that Resemble Filing Cabinets.—There has lately been introduced a new type of switchboard in which each unit, consisting of a front panel on which is mounted the apparatus, and an iron framework carrying the necessary equipment in the rear of the panel, is fitted with a pair of wheels. The unit may be readily wheeled about if necessary, and wheeled back into its proper place in a switchboard, in which case it is entirely protected by a metal housing. It is claimed that workmen cannot come in actual contact with the "live" parts of the switchboard while the current is turned on. The feature of being able to remove and replace any unit reminds one of a vertical filing cabinet, and this too is an important point in its favor.

Magnetic Chuck Work.—A manufacturing firm is making good use of magnetic chucks by using one to hold 104 needle pointing dies at once while the operation of grinding on one side is being performed. They are ground on four sides in this manner, and the time saved by the use of the magnetic chuck is almost beyond calculation. Can you conceive of holding them one at a time, since they are little blocks of steel ⅝ inch square, and grinding them that way? Grinding these dies on four sides, accurate, smooth and square, 104 at a time, consumes only about three minutes each. These dies are used for making knitting needles. Obviously, the dies are strongly magnetized from the action of the magnetic chuck. To demagnetize them they are wiped across the top of a demagnetizer.

Novel Lifting Magnets.—According to the *Mechanical Engineer*, a British firm has designed a lifting magnet in which the whole of the magnetic flux is utilized for lifting effect, there being no diversion of the lines through the chains or suspension gear. There are two rectangular soft-iron pole-pieces with a cylindrical core between them, and two annular coils wound on the core and connected to a convenient source of supply. Between the coils and equidistant from the pole-pieces is a central rectangular plate, to the top corners of which are attached two chains united by a common ring through which the chain hook passes. This central plate does not become magnetized when the current is turned on, consequently the attachment to it of lifting chains does not divert the magnetic flux from the main work of lifting the load.

Electrically-Driven Fire Apparatus. — The speed, power and flexibility of electrically-driven fire apparatus were recently demonstrated in a test made in Paterson, N. J. A combination chemical engine and hose wagon, with its crew of 14 men, and an aerial ladder truck, with its crew of 22 men, were used for the demonstration. The two pieces of apparatus were both converted horse-drawn trucks. In the first test both trucks ran up an 18.23 per cent grade, the first in 1 minute 13 seconds, and the second in 1 minute 18 seconds. On climbing this hill a second time both trucks were stopped in the center of the steepest part of the hill and then run to the top at the same speed as before. In another test on another hill, also over an 18 per cent grade, both trucks negotiated the hill in 1 minute 20 seconds, the best previous time made on the hill being over 2 minutes. In a further demonstration a speed of 30 miles per hour was maintained on a level stretch of about one mile.

Astronomy

Illustrations in Harvard Observatory Publications.—A valuable list of the illustrations that have appeared in the Annals and the Circulars of Harvard College Observatory is given in the recently published Annals, Vol. 80, No. 3.

The Temperature of the Sun.—The latest estimate of the absolute temperature of the solar surface is that of F. Biscoe, of Warsaw, whose computation is based upon the intensity of radiation for individual wave-length in the solar spectrum as obtained with the spectro-bolometer at the Smithsonian Astrophysical Observatory. He gets an average value of 7,300 deg. + 100 deg. Cent.

Recent Auroral Displays.—The recent recrudescence of sunspot activity has been accompanied, as usual, by numerous and splendid displays of the aurora borealis. The series of displays began last autumn and is still in progress. Hence it behooves dwellers in the northern half of the United States and in Canada to scan the northern heavens on moonless nights, lest they miss seeing the more remarkable of these phenomena.

Highest Latitude of a Sunspot.—Sunspots are generally confined to two zones of the sun lying between solar latitudes 5 and 40, north and south. In 1846 Prof. Peters observed a spot in lat. 50.4 deg. This record has now been surpassed by a small spot which appears on a photograph of the sun taken at the Royal Observatory, Cape Town, Dec. 26, 1915; its latitude being 59.6 deg. S. The late E. L. Trouvelot claimed that some of his "veiled" spots, which look like dark masses floating a little below the surface of the photosphere, could be traced to within 10 degrees of the pole, but this assertion is of questionable accuracy.

A New Catalogue of Variable Stars is being compiled at the Harvard Observatory. Whereas in 1896 a catalogue, published by Chandler, of all the variable stars then known included only 393 objects (in addition to suspected variables), so much progress has been made in 20 years that the new catalogue will contain 4,641 stars of known variability. Nearly three-fourths of these have been found at Harvard Observatory, which, with its collection of a quarter of a million stellar photographs, has the most complete material in the world for the study of variable stars. The periods of variability of these stars range all the way from three hours up to 698 days.

Washington-Paris Longitude. — The U. S. Naval Observatory has published a detailed report on the determination of the difference of longitude between Washington and Paris carried out in 1913 and 1914 by means of radio signals transmitted by the Eiffel Tower and Arlington stations. This method, which far exceeds in accuracy that used in ordinary telegraphic determinations, gives for the difference in longitude between the Paris and Washington national observatories 5 hours, 17 minutes, 36.653 + 0.0031 seconds. This differs by less than a tenth of a second from the average of previous telegraphic determinations. A number of American observatories made use of the time signals emitted from the Arlington station in connection with the Paris-Washington longitude work to determine their own longitudes from Washington.

The Earth's Influence on Sunspots.—The influence of the planets upon sunspots has been the subject of numerous investigations. The probable existence of a variation in the latitude of sunspots corresponding in period to the terrestrial year was established by C. Braun, while a variation of like period in the frequency of spots was determined by Mrs. Maunder. Dr. Henryk Arctowski, of New York, has taken up this problem anew, using the Wolfer sunspot numbers and the spot areas given in the Greenwich catalogues, and he finds a variation in the mean latitude of sunspots, with an amplitude of at least 4 degrees, having a period of a year—i. e., corresponding to the earth's revolution period, and hence due in some way to the influence of our planet. There seems, however, to be a lag of about three months in this terrestrial action.

Largest Known Proper Motion of a Star.—A comparison by Professor Barnard, by means of the Zeiss blink microscope, of a recent stellar photograph with one made 18 years ago, has led to the discovery of a star in Ophiuchus, of visual magnitude 9½, having the remarkable proper motion of 10 seconds a year—greater than any previously known. It is moving nearly due north. The next greatest proper motion known is that of an eighth magnitude star in the southern heavens (G. C. Z., V, No. 243), which drifts 8.7 seconds yearly; while the third in rank—which for many years headed the list—is the 7th magnitude star Groombridge 1830, the so-called "runaway star," which has an annual drift of 7 seconds. It will be noted that all three of these stars are invisible to the naked eye. The fastest of them takes 187 years to drift a distance equal to the moon's apparent diameter.

Invention Notes

Tungsten Made Malleable. — The manufacture of tungsten lamps will be simplified by the invention of Alexander Just of Budapest, Austria-Hungary, recently covered by a United States patent and assigned to the General Electric Company. Tungsten when melted or solidified is not malleable, so that it cannot be worked or drawn into wire. The addition of two per cent of boron or boron nitrate to the fused mass of metallic tungsten seems to overcome this difficulty, which forms the basis of the patent.

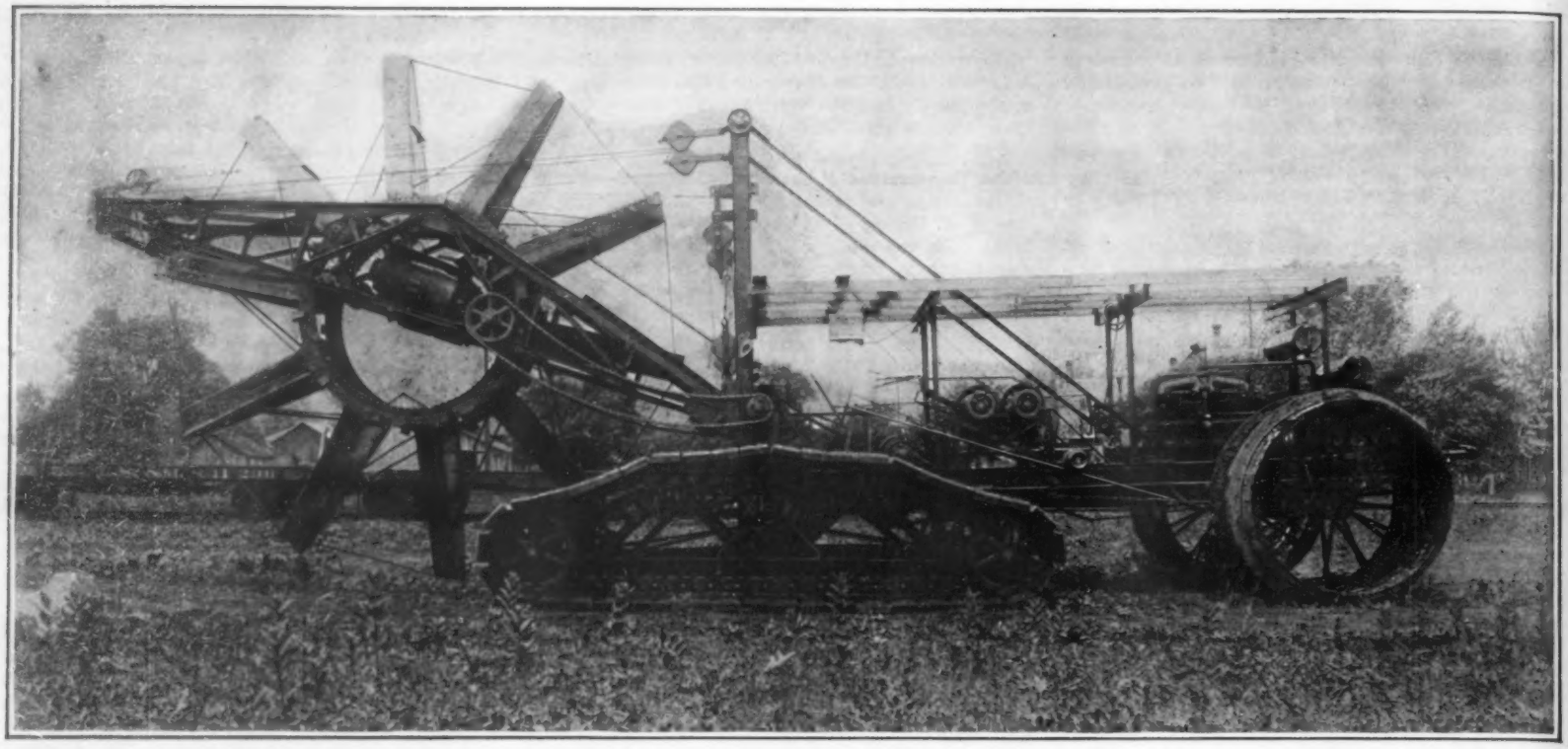
A Pedestal Polishing Lathe and Grinder of new design has special provisions for salvaging the dust when working with valuable metals. The complete outfit consists of a motor mounted on the pedestal equipped with fan, dust traps, and universal hoods. When polishing and grinding are being done the released particles are thrown against the hoods and shields and drawn downward through the vertical suction pipes. During its passage the dust is separated from the air by means of four dust traps. The machine is entirely self-contained and requires no elaborate system of pipes for its installation.

Sharpening Stone on the Electric Cloth Cutter—A new electric cloth cutting device has a thin, circular knife which revolves at a rate of 6,000 revolutions per minute, which carries it through many thicknesses of cloth which a cutter would not be able to handle with the ordinary shears; and it does its work so quickly that its capacity is limited only by the ability of the operator to follow the pattern. The passage of the knife through the material takes the keen edge off the knife rather quickly, and, in order to take care of this, a small emery wheel is attached to the device, where it is always ready for use, so that the knife may be sharp at all times. The revolving knife is secured directly to the motor and is driven by a small belt. The weight of the motor assists the operator in holding it down to the work.

Camp Cots Combined with the Tent Frame.—The camper or outdoor enthusiast will be interested in a new arrangement which he will see among the camping paraphernalia this year in the shape of a combined tent frame and cot, which will greatly simplify the matter of transporting the sleeping accommodations around the country, since it disposes of these very necessary adjuncts of the camp in a very small space. The tent supports are of angle iron, the longer pieces as well as those forming the two cots which go with each tent, are jointed so that for the purpose of storage or shipment they may be packed away in small space. The frames of the cots are suspended from the uprights by two coil springs, which further serve to make the beds comfortable. During the day, when there is no demand for their active service, the cots are neatly disposed of by releasing one of the springs at each end and folding up against the tent frame.

Heating Element in the Kitchen Tank.—Without making any change in the kitchen tank, an electrical heating element may be inserted in it by means of which the water may be warmed by the current when, as in the summer time, for instance, it is desired to dispense with the operation of the range and yet at the same time there is a demand for hot water. In construction, the heater is a rod an inch and a quarter in thickness and about 56 inches in length, threaded at one end so that it is only necessary to insert this unit through the standard opening to be found at the top of any ordinary range tank. This rod is filled with an insulating, non-oxidizing fluid in which the open resistance coil is submerged. It is claimed that all the energy supplied to this heater is dissipated in the water in the form of heat, without loss, making the device very efficient in its operation. The heaters are supplied in several sizes, ranging from 500 to 2,000 watts, the larger sizes being equipped with a three heat control.

Turntable Wear and Tear Eliminated. — The unusual pounding which takes place when a locomotive is run onto a turntable represents waste and inefficiency, which seem to have been effectively overcome by a new system of turntable construction being followed by the Atchison, Topeka and Santa Fe Railroad Company. The radial tracks extend to a point seven inches back of the face of the circle wall, and are supported in cast steel bearing blocks which rest on the concrete circle wall. The table rails project 6¼ inches over the circle wall and are supported on wedges which slide in and out on the bottom flanges of the rails and rest on the bearing blocks supporting the radial track rails. The same system of wedges is used under the circle rail in the pit, and when pounding develops at any point it is the matter of but a few minutes to remedy it by making the proper adjustment of the wedges. The records of the company show that the cost of maintenance of the trucks of these turntables heretofore has amounted to $500 per year.



One of the huge ditching machines used in cutting the canals for the reclamation of the Everglades of Florida. A cabin for the crew has been placed on the beam work over the power plant, after this photograph was taken

Reclaiming the Everglades of Florida

How Huge Ditchers Are Cutting Miles of Drainage Canals Through the Waste Lands

By Day Allen Willey

THERE are some 4,000,000 acres of waste land in Florida, according to the survey of the State engineer, that can be converted into productive farms and attractive gardens through reclamation by drainage—1,500,000 acres more than the territory reclaimed by the United States Irrigation Service. The great variety of crops and the average yield per acre from the land already reclaimed caused a thorough study to be made not only by the State engineer but also by Engineer J. G. Wright of the Department of Agriculture, the engineers of the Florida East Coast Railway, and a dredging company of Baltimore, which was first employed by the State to undertake the cutting of the drainage canals from Lake Okeechobee, the flood source, to the tidal river.

After a comprehensive and accurate survey of the topography of the Everglades, it was proved that this part of Florida could be reclaimed by gravity. The first project taken up by the dredging concern was gone over by their engineers to verify the Wright report before the actual work started. The contract included the excavation of four canals of a total length of 200 miles and of an average depth of 5 feet with a 60-foot width. When the first canal was completed it flowed from the lake into the New River by the natural incline of the waterway, the rim of the lake being 20½ feet above sea level.

Six dredges were employed by the dredging concern in carrying out the initial contract. Aside from the dredges for removing the rock formation, the tooth bucket dippers and suction dredges, there was also included in the equipment of the workers a floating dynamite plant for shattering the hardest rock. The excavating dredges included a dipper and suction pipe operated from the same arm.

The largest dredge in service was equipped with a 150-horsepower plant and a suction pipe with what is termed a revolving cutter head. The latter was forced through the water, the plant growth, and the mud, carrying the material scooped up in a liquid state through the hull and depositing it on the bank of the excavation. The suction excavator was operated by a 12-inch pump with a capacity for removing 5,000 cubic yards in ten hours.

For hard formation, the Everglades contractors made use of a special dredge. This machine had a bucket capacity of 2½ cubic yards and was one of the most powerful type of dredges constructed up to that time.

In the accompanying views appear a few of the ditching machines employed in the Everglades reclamation work. One of these ditchers, operated by gasoline power, not only digs trenches, but also pulverizes the surface of the muck lands so that they are ready for farming after the drainage has been completed. The same machine, it is claimed, has a capacity of over 500 linear feet of soil in 10 hours.

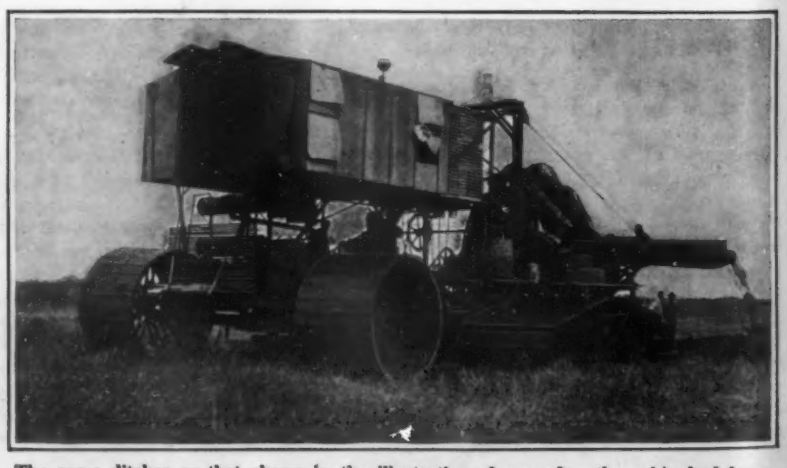
Another ditcher employed in the work is operated by a steam power plant. Its teeth, mounted on a large wheel, are capable of cutting a trench 400 feet long every working day, to a depth of 6 feet and a width of 3 feet. Still another type of ditcher, operated by a gasoline engine, is equipped with a cabin placed over the power plant. In this cabin there are berths for all members of the crew, who can sleep comfortably in their lofty quarters, no matter where the machine may stop work for the night. On top of the cabin is a searchlight, which serves to good stead in nocturnal operations and for the pleasure of the crew.

The first excavation work included canals extending from cuts through the rock rim of the lake to tidal rivers. The complete canals range from 50 to 60 feet in length, and have a depth of 6 to 7 feet. The cutting of 2,000 miles of lateral canals by gasoline ditchers served to reclaim 1,500,000 acres of swamp land through which the water flowed into the canals. And the success of this work proved that the remainder of the Everglades—2,500,000 acres—could be reclaimed by the natural incline of the surface, from the flood source to the rivers entering the sea. There has since been a second contract taken up by a subsidiary of the Baltimore dredging concern for the reclamation of another large portion of the Florida waste lands, which will make all the waste lands, or a total of 4,000,000 acres, ready for cultivation when the work is completed.

The new contract includes the excavation of nine canals, aggregating 425 miles. All of these waterways are now under way, with widths ranging from 50 to 60 feet for the larger ones, and an average of 25 feet on the three smaller ones. The depth of the main canals ranges from 5 to 7 feet, while the others average 4 feet. The work of excavation being performed by dredges makes use of such types as the dipper, clamshell, and suction machines, also two floating dynamite plants for rock excavation, which are equipped with steam-driven shovel buckets for removing the rock blown out from the bed of the cut.

So much of the last reclamation has been ac-

A ditcher that not only digs trenches four to six feet deep but also prepares the soil for subsequent farming

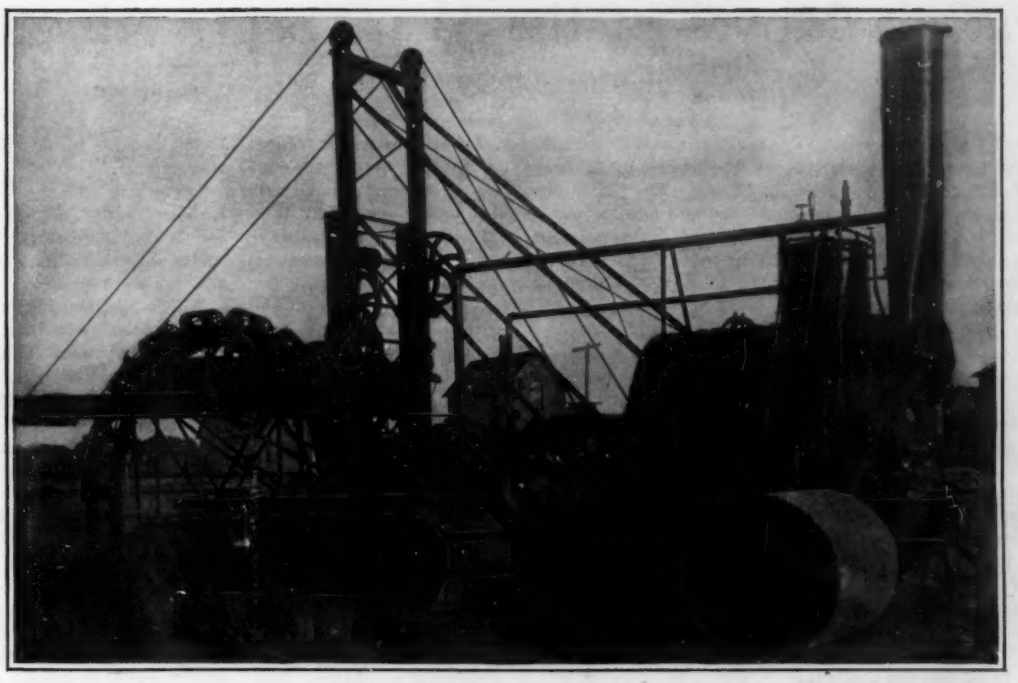


The same ditcher as that shown in the illustration above, after the cabin had been mounted in place

complished that within a year the entire area will be ready for the farmer and the settler. The 4,000,000 acres represent only a small proportion of the total swamp lands of the United States on which millions of people might find homes and occupations, if they were properly drained. And drainage is not only possible but also inexpensive, considering the value of the land reclaimed for settlement.

The Everglades, where drained, are being occupied by settlers from many other parts of the country. Every kind of fruit and vegetable raised in the temperate zone can be cultivated at a profit in Florida. Oranges, bananas, pineapples, and other varieties of tropical tree and bush products may be added to the list of fruits. The farms under cultivation since the reclamation work prove this to be true. The new land is being sold in large tracts by the State authorities to be divided into truck and other farms by large corporations that have been organized in various cities, but the possibilities for producing sugar are perhaps the most important.

It is interesting to note in passing that while the Government went to an estimated expense of $50,000,000 for the cost of reservoirs and the necessary work, including irrigation canals, the State of Florida will reclaim a great submerged area one third larger than the total irrigation acreage by a bond issue of $4,500,000, or less than one tenth the cost of the Federal irrigation project.



Steam-operated ditcher with a capacity of 400 feet of trench six feet deep and three feet wide per day

A Machine That Prints One Hundred Miles of Printed Matter in Ten Hours

By Oswald T. Carliss

ONE hundred miles of printed sheets in 10 hours—not newspapers, but high-quality 9 x 12 printed matter—is the productive capacity of a remarkable printing press now in operation in New York City. The machine can be used for almost any class of printing; as an example, it prints tickets in two different colors on both sides, each bearing an individual number, perforated to tear at the proper place, and having a triangular piece cut out of each side, the finished tickets being rolled into a solid wheel one foot in diameter ready for the ticket booth of a subway or motion picture house, as the case may be. Ten hours' production of these tickets, if placed end to end in a straight line, would stretch over a distance of some 400 miles. And this is by far one of the easier accomplishments of the newly-introduced printing press.

Printing labels in several colors is a forte of the new printing machine. It will turn out labels in four colors for canned goods, beautifully printed, at the rate of 4,000 impressions per hour and delivered cut to the exact size to fit the can. Again, it will print match-boxes in two colors on both sides, and perforate, score and cut them out with a die without affecting the rate of production. Once more, the machine may be used to produce gum labels in two colors and punched with holes similar to a mileage ticket, or it may be bill-heads perforated for tearing off various portions and punched in two or more places for convenience in filing in loose-leaf binders. Baggage tags can be printed, die cut and reinforced by a piece glued on around the hole with the machine scarcely making more noise than a dozen typewriters.

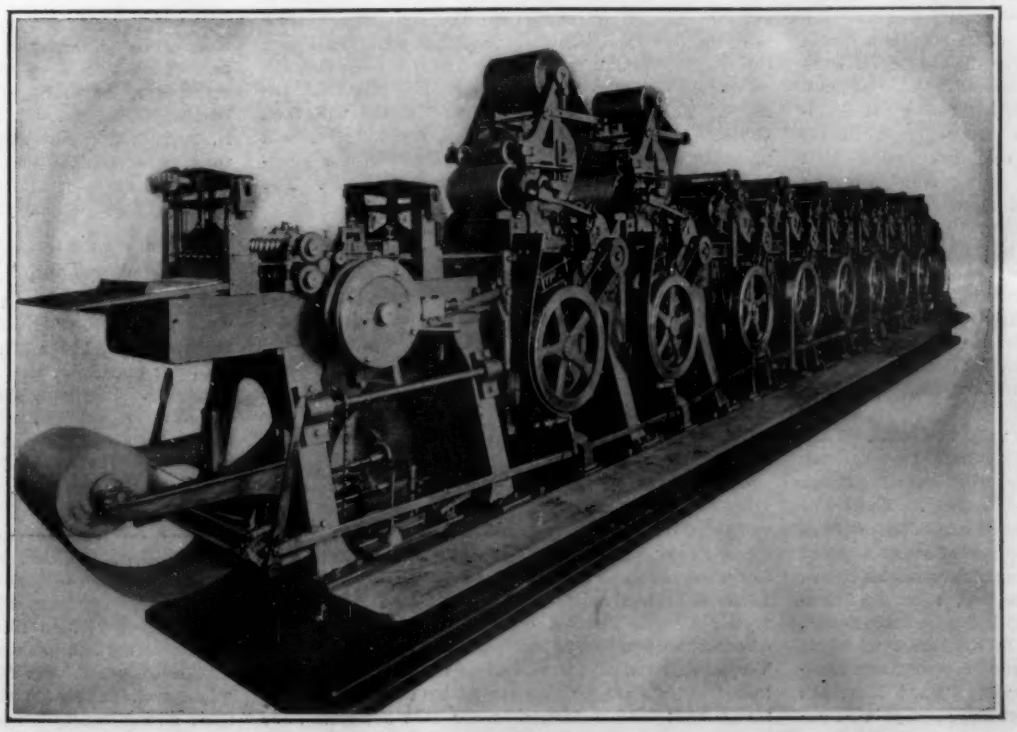
The new printing press is made to take sheets ranging from 6 x 6 inches to 9 x 12 inches, and is fed from a roll of paper somewhat after the fashion of a newspaper press. The roll of paper is controlled by a device which prevents it from being fed into the machine too rapidly or too slowly. The machine is built in sections, varying in length according to the number of operations it is intended to perform; in fact, it may be looked upon as a series of printing presses, folders, die-cutters, slitters, scorers, gumming machines, and other printing equipment combined into one unit. The machine illustrated is 4¼ feet high and 23 feet long, of a weight of about 14,400 pounds. Its operation calls for a 7-horsepower motor.

The edge of the paper used in the press is gripped by rollers and proceeds into and under the first printing press, which is operated much in the same manner as a small trip hammer, the type being locked in the chase and brought down on the paper for the impression. The inking rollers ink the type or form with a sweeping motion, and if the job at hand is to be printed on both sides, the small presses under the machine are operating in a like manner. Any press can be stopped and others kept operating; for instance, if the underside of the sheet is plain printed matter while the top side is color work, then the number of operating presses underneath the machine center are less than those above, and vice versa. Another feature of the machine is that the punching and perforating mechanism can be regulated to punch or perforate at any speed or in any position in the sheet passing through the mechanism. As an example of the versatility of the machine in this connection, let us take a combination original and duplicate bill-of-lading, which is to be printed on both sides and perforated through the center so that the duplicate can be torn off from the original. The original can have two or more holes punched in the top or side of the sheet, while the duplicate sheet can be passed through without holes. The numbering mechanism can be adjusted so that the original and duplicate forms will receive the same number, changing only for the next two sheets.

The illustration fails to show the underside printing press mechanism because of the side frames which hide it; but in general construction this mechanism is practically the same as the presses operating from above, the only difference being that the type is brought to the paper with an upward movement and leaves its impression on the underside of the sheet. The fine register obtained on the machine, considering the great speed, cannot fail to appeal to the printer; while to the mechanical engineer the synchronism of the multitudinous operations is a study in itself well worth investigating.

The slitters, as the name implies, are used in cutting the full sheet lengthwise into varying widths for narrow strips of paper or cardboard, such as tickets or tags. These are in the form of knife-edged disks which press down firmly on the paper that has already passed through the printing presses.

In sum, the machine consists of a number of printing presses handling any number of colors on both sides of the sheet; perforating mechanism to perforate the work in any manner desired; slitters to slit any sized sheet up to the capacity of the machine; punching devices to punch any number of holes at any required distance and of any size; scorers to score paper boxes, cartons or match boxes to permit of their subsequent folding; gumming facilities for gumming labels and shipping tags, and to reinforce tags with linen; cutters to cut any sheet to a given size and to cut tabs on index cards, and a numbering machine to number the work consecutively or individually. In truth, the machine does the work of eight distinct machines usually found in the better equipped printing shops.



Consisting of a number of machines grouped together to operate as a unit, this printing press is capable of a wide variety of work

Lobster-Rearing Plant on New England Coast

THE sundry civil appropriation act, approved July 1st, provides $5,000 for the construction and equipment of a lobster-rearing plant on the New England coast. The United States Bureau of Fisheries is now making investigations to determine the best available location.

The Bureau hatched 128,700,000 lobsters in Maine and Massachusetts during the year ended June 30th, but owing to the character of the facilities available at the hatcheries it was necessary to plant them almost immediately after they had issued from the egg. At this stage they swim near the surface of the sea and are particularly subject to destruction by fishes. The new plant will make possible the rearing of a considerable number of them to a stage at which they acquire the habit of seeking safety among the rocks and in the crannies of the sea bottom. It is especially designed to prevent the practice of cannibalism, which produces a situation similar to that of the Kilkenny cats when large numbers of the little lobsterlings are confined in a small space and which defeats attempts to rear them in the existing plants of the Bureau.

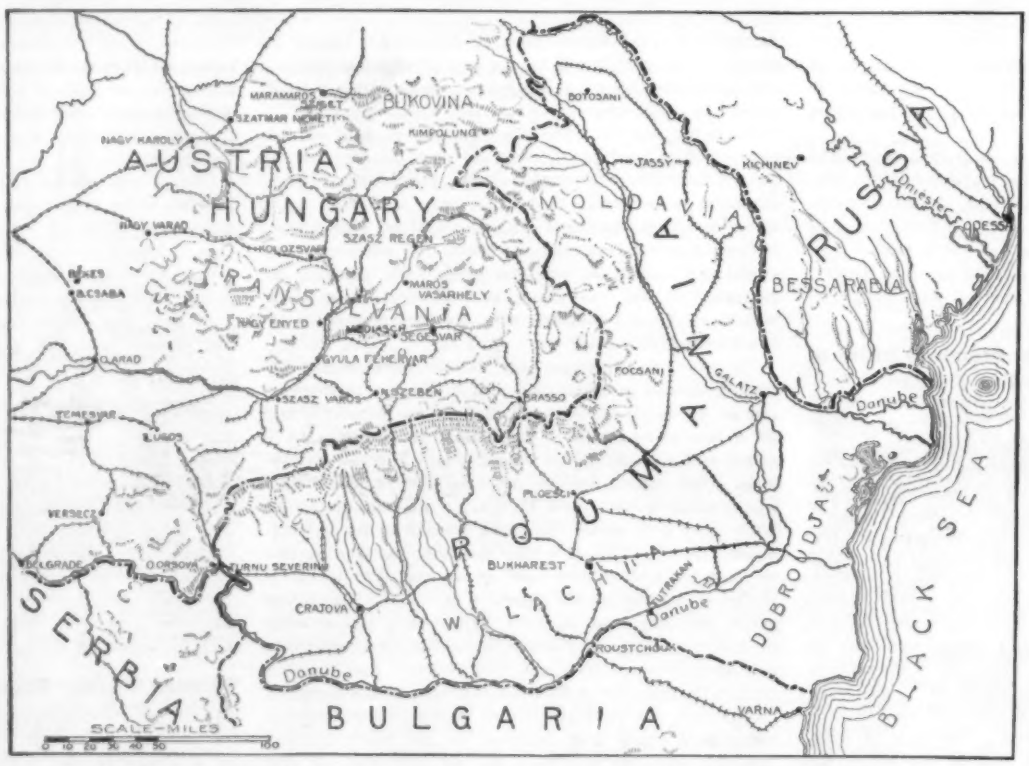
Strategic Moves of the War, Sept. 7th, 1916

By Our Military Expert

THE time which has elapsed since the entry of Roumania into the war is yet too brief to permit a definite view as to where the Teutonic forces will elect to make their stand in Transylvania. The minor engagements which have occurred are but preliminary, the setting of the stage for the Great Drama. At first glance, the reports of Roumanian progress might suggest that the Entente is delivering its thrust directly upon Austria-Hungary; but a closer inspection of the map, a consideration of the topography and a weighing of the military situation all tend to upset such a theory.

To begin with, the southeastern corner of Transylvania projects eastward into the Roumanian pocket, forming a large and deep salient, a danger in itself, for, while the territory is well supplied with means of communication by three main railways, a successful Roumanian attack upon either end of the salient would certainly endanger all Teutonic forces remaining within the included rough terrain. In addition, should the kaisers elect to hold the frontier line in this section it would call for vast numbers of troops. To obviate then the danger of the weakly held salient, permit a more feasible line of defense to be manned and gain such a line as can be reasonably secured by a less number of troops, it is apparent that Austria-Hungary had determined in the event of Roumanian intervention to abandon the salient under reasonable pressure and take up position where the above-mentioned gains would be registered.

This is a situation where gain should accrue to each contender by the retirement of the Teutonic forces. The Entente is naturally glad to follow the Austrian retirement as closely as possible, gain certain conceded territories, but, most of all, safeguard the operations against Bulgaria which are in course of preparation for launching, by keeping the menace of problematical flank attack as far away geographically as possible. It has long been a maxim of warfare to fight with superior numbers against lesser whenever possible, to fight in detail, and to eliminate the weakest link in a chain of defense as soon as possible. The position of Bulgaria, supported by a comparatively few German and Austrian troops, and by a larger number of Turkish, is a threat to any operations which might be directed upon Hungary, so long as Bulgaria is unmolested. But once Bulgaria (and her local supporting forces) is eliminated, with Serbia recovered, the line to Constantinople cut and Turkey isolated, the combined attack from the southeast upon Mackensen may proceed with no danger to it other than that of direct resistance.



Map of Roumania and the province of Transylvania, showing strategic positions in the latter

The map of Transylvania shows three feasible lines of defense for Austria-Hungary, along successive chords of the arc formed by the Roumanian frontier. The country is difficult, broken and mountainous; but the backbone of each of these defensive lines lies in the railway which practically parallels it in rear, and furnishes a means of lateral communication along which troops may be shuttled to meet a broad and heavy attack launched at any point.

The first two lines are not unbroken ones. That nearest the Roumanian frontier begins (the railway line) about 50 miles south by west of Kimpolung, thence to Szasz-Regen—Maros-Vasarhely. There the line will probably take advantage of two other railways farther to the southeast, and the line may sag forward until it covers those two railways, through Mediasch, thence back again to the main line, covering Szasz-Varos and on to the junction with the Temesvar road.

The second line of defense is coincident with the first as far as the skip to embrace the southern roadways. But instead of bending southward here, the line continues southwest to Nagy-Enyed—Gyula-Fehervar—Szasz-Varos—Lugos—Temesvar.

The third line is practically the last one, and is by far the most important, for, directly to westward of it the plains of Hungary lie inviting to the foot of invasion. The plains once gained, the Carpathians are turned and must be evacuated in haste. This third line begins at Maramaros-Sziget, then covers the railway loop to the westward across a gap, which practically requires an advanced position, thence to the railway again at Szatmar-Nemeti—Nagy-Karoly—Nagy-Varad—Bekes-Csaba—O. Arad—Temesvar—Belgrade. If this line is reached and passed by such composite forces as the Entente may elect to assign to the task, Austria will be in a precarious situation indeed, for the problem of supply for the Entente forces will be an easy one with the wealth of railways at hand for the purpose.

On the Macedonia front two things are evidenced from the reports. There have been constant raids throughout the line with several marked reconnoissances-in-force, clear attempts to feel out the line and determine the weakest and most promising point for the major stroke. Secondly, the artillery activity is increasing to a point which seems to presage delivery of the attack. Before these lines are printed, the general assault may be under way.

There is, however, ample reason for non-haste. The same principle of attack in detail obtains here and it seems a matter of course that the main attack from the south, by General Sarrail, will not come until such time as the Russian troops which are streaming through Roumania are in position to attack Bulgaria from the north. The long-expected "nipper" action will then contain a rich promise of success, for Bulgaria will probably be compelled to fight at least twice her available numbers on two fronts at the same time. The prospect for Bulgaria is not enticing.

In the meantime, the Russian troops which recently reclaimed Bukovina for themselves during their great offensive, seem inclined merely to hold on to the gains they have made while the game of strategy requires the shift of troop masses elsewhere. To prevent the Austrians from weakening their lines in Volhynia, Galicia and Bukovina, the Russians occasionally make spectacular and strong attacks either to achieve the purpose as stated above or take advantage of any weakness which may have arisen through necessities for weakening a front.

On the western front, after comparative inaction—comparative, because few definite gains have been secured through incessant fighting—the German Somme sector is again the scene of determined assault. Despite the efforts of the French at Verdun, the Germans seem to have broken off their action there and have effected a redistribution of troops to meet the new emergencies which now confront the Central Empires. Verdun seems now a dead letter; there are major and minor attacks in the vicinity by both sides, yet Germany must confess failure in her vast enterprise, for the French lines have remained unbroken, the moral victory of the months-long battle-siege accrues to Joffre, and the initiative seems now to lie entirely with the Entente.

There has also been comparative inaction on the Italian front. Italy assembled her resources for the forcing of the Gorizia bridgehead, expended her reserves of ammunition and supplies with lavish hand, and before the great attempt is made to force the Carso plateau and thrust home to Triest, these must all be replenished and plans formulated to minute details for the great task. This takes time; in the meantime, Austria dares not let go there for a moment—and Italy is "doing her bit" in the great scheme of affairs.

In Asia Minor, the Grand Duke is not relaxing his pressure. His troops have penetrated so far in the face of obstacles of nature, poor lines of communication—they are mostly a jeer—and to-be-expected losses, that considerable time must be necessary for him to prepare for attack upon the main line of defense which runs through Sivas as a center. And again, Turkey in turn dares not weaken her lines to help her nearest neighbor in trouble, Bulgaria, for it takes weeks to transport troops and their supplies from Turkey-in-Europe to Turkey-in-Asia. It is almost a case of showdown, to be fought out with the cards on the table as they now lie.

Is Germany ready to give in? Far from it, if one may judge from the tone of the Teutonic press. Despite, however, the official attempts to uphold the morale of the people, there is no disguising the fact that the seriousness of the situation is realized in Berlin and Vienna. To date—and still—the Kaiser is fighting mainly upon the territory of his enemies. The lands of the Central Empires are scarcely touched as yet by the Entente. But if the Teutonic Alliance decides to carry on the fight in the face of double numbers and increasing military resources, whenever it concludes to fall back upon its own lines of defense, within its territories, the most gruelling battles of the war will come.

There is no immediate prospect of Germany and Austria being compelled to retire. It is believed this must await the outcome of the brewing Balkan operations, which have for their ultimate object the invasion of Austria-Hungary and its subjugation. If Bulgaria is eliminated, Turkey too, before winter locks up the land, there is a prospect of realization by the Teutonic Powers of the increasing hopelessness of the situation, peace on the best terms and the end of the war by springtime. But if, instead, Germany and Austria elect to fight it out to a finish within their own frontiers, there can be only one end to it all; but the toll of bloodshed will dwarf all which has gone before in this most cataclysmic of wars.

"Crocker Land" Erased from the Map

IT at last appears to be established that the so-called "Crocker Land" reported by Peary as lying 130 miles over the Polar Sea from the coast of Greenland does not exist, and that the Admiral was deceived by a mirage. Such are the conclusions reached by the McMillan expedition, which left New York in 1913 for the principal purpose of proving or disproving the existence of this body of land, as reported by Lieutenant Fitzhugh Green, U. S. N., the Government representative with the expedition.

Under the most favorable weather conditions, Lieutenant Green and Mr. McMillan personally traversed the entire region in which the alleged land was said to lie, making soundings which uniformly gave "no bottom." Moreover, on returning to their base at Cape Thomas Hubbard, they observed a mirage of a mountain range which, but for their previous observations, might well have been taken to be real land. Under these circumstances it would appear pretty certain that the "discovery" of Crocker Land merely furnishes one more instance of Jove's nodding.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Moon and the Weather

To the Editor of the SCIENTIFIC AMERICAN:

A theme of perennial discussion is the relationship, if any, between the moon and the weather and, particularly, whether the moon at or near opposition (full moon) has any activity in dispersing clouds. Reports differ pro and con. As far as I am aware a very important point in connection with this discussion has not received the attention it merits. I allude to the difference in distance of the moon from the Earth as between perigee and apogee, a difference of, roughly, 26,000 miles. When the moon is nearest to the Earth, at or near opposition, it is manifest that the intensity of heat received on the Earth by radiation from the moon is greater than when the moon is at apogee in that part of her orbit. My observations covering many years indicate that the heat radiated from the full moon at perigee does operate to clear a cloudy atmosphere.

W. E. GLANVILLE.

Solomons, Md.

An Appreciation

To the Editor of the SCIENTIFIC AMERICAN:

I should like to thank you heartily for your article and diagrams in the June 17th number, on the North Sea Battle. Without the diagrams it would have been difficult to understand the various fragments that appeared in many papers before the official report of Jellicoe. By cutting out colored pieces of paper to represent the battleships, cruisers, etc., it was not difficult to follow the movements of the two navies.

After working it out carefully a number of times with the bits of paper on a table, I was soon able to do it from memory so when the official report came it was an easy matter to fill in, and to make such trifling corrections as need be. Nothing could be more excellent than your article as a basis of a complete knowledge of the battle, and when the official German report is in, one can then more easily follow the details.

I should think also that it would serve as an entertaining way for mothers to keep boys interested during these hot days and would incidentally train to accuracy of statement in general discussion.

For this, and many other articles noteworthy, not only for their informative value but for their awakening of intellectual curiosity, and, as a housekeeper, for such articles as the Industrial Preparedness for Peace of July 22nd, please accept my grateful thanks.

A CANADIAN WOMAN.

Another Remarkable Watch

To the Editor of the SCIENTIFIC AMERICAN:

We notice in a recent issue of your publication an illustration showing a complicated watch. May we bring to your attention another timepiece which, by virtue of its calendar mechanism, is much more intricate than the one illustrated?

The inner dial at the top or "12" of the watch is divided into four sections, each section divided into months and the fourth section shows 366 days making provision for leap year. At the bottom the inner dial has a hand that travels around the dial once in one second, stopping at the fifths, which are indicated, just long enough for the eye to catch it. Then the other two inner dials show the day of the week and of the month, as well as the moon calendar.

The split second hands (two) make the watch a friend of the racing man. On top of all this is the striking apparatus, making a repeater of this timepiece. It repeats the hour, the quarter and the minute.

It is interesting to note there are eight hands on this watch, of which two revolve about their dial in one minute, and the others in one second, one hour, one day, one week, one month and four years, respectively.

Interest may attach to the reason for making this. An American magnate while in Switzerland ordered "the most complicated watch that could be made" for one of his operating superintendents. The genius worked out one like the above, and showed it to an Omaha packer who ordered a duplicate. This means that there are but two such timepieces in the world.

HARRY E. RYAN.

Omaha, Neb.

One Way Out for the Railroads

To the Editor of the SCIENTIFIC AMERICAN:

As a support for the military the railroads of the United States should be operated in time of peace as well as war by enlisted men. This would improve their efficiency and insure the public against loss by strikes.

The United States Government could Federalize labor employed on interstate railroads by levying upon them a per capita tax, using the receipts to maintain representatives in a National Department of Transportation as spokesmen for the just needs of the men. All this would save the confusion that originates from the idea that "Force is the midwife of progress."

F. C. RIVERS.

A Question of Numbers

To the Editor of the SCIENTIFIC AMERICAN:

The writer, a native of Greece, returned from a visit to his old home in Epirus two months ago, and is therefore in a position to give some information about the state of things over there as existing three to four months ago. From Greek officers in Macedonia I gathered the information that there were about 130,000 to 150,000 Allied troops in the country, mostly Serbians, some French colonials and a handful of British.

Better send your esteemed military expert to the land of "to-morrow morning" so he will be able to forget General Sarrail and his 600,000.

GEORGE COMTHOS.

San Bernardino, Cal.

The Stars in Daytime

To the Editor of the SCIENTIFIC AMERICAN:

We were much interested in an article on the "Visibility of Stars in Daylight," which appeared in the August 5th issue of the SCIENTIFIC AMERICAN. While we agree with you as to the futility of the means by which stars are said to be made visible in daylight, it seems to us that broad daylight might not be an obstacle to the printing of stars on the photographic plate if an equatorial *provided with an infra-red filter and plates sensitized with the alizarin blue, silver nitrate and ammonia process* were used. The scattering of light by the atmosphere decreases rapidly as the wave length of light increases. It is by far less apparent in red than in blue light That "red and yellow stars are more easily seen than white ones" in daylight, with the telescope, is but a consequence of that law. In the invisible infra-red the scattering of light by the atmosphere is practically nil. On photos made with infra-red sunlight, in the neighborhood of 9,000 Angstrom units, objects eight kilometers distant appear as clear and as well defined as if they were but a few meters away. If, instead of losing rapidly its sensitiveness from the greenish yellow down to the extreme red, the human eye were sensitive to the infra-red radiations, and only to them, many stars would shine for us in broad daylight on what would then appear to us as an absolutely black sky, and, owing to the cumulative effect of the photographic plate, a considerable number of stars ought to be visible on photos made in infra-red daylight with an instrument automatically following their diurnal motion.

GUSTAVE MICHAUD,
J. FID. TRISTÁN.

San José, Costa Rica.

The Citizens' Naval Bill

To the Editor of the SCIENTIFIC AMERICAN:

I desire very heartily to commend the outspoken utterances of your journal on all important public questions as appearing in your editorial columns from time to time, and especially your recent article in last week's number on the Citizens' Naval Bill.

It is gratifying to find a representative press so free from partisan bias or fear of official frowning as not to be afraid to criticise where criticism is justified regardless of where the shafts may strike.

This administration no doubt will receive, in part at least, the credit for whatever value there is in this naval bill and kindred measures of preparedness, but the real credit therefore, in my opinion, should go where it belongs, to an enlightened public opinion stimulated by the work of The Navy League, The National Security League and others. These societies and courageous journals such as yours have *led* rather than *followed* public opinion.

As a reader permit me to thank you.

C. H. EARNEST.

Colorado, Texas.

Stripping Gears

To the Editor of the SCIENTIFIC AMERICAN:

L. B. Baker's letter on his unhappy experience with the gears of his motor car, due to his ignorance, touches on a matter that is merely a ramification of the big and vital subject of Service. Thorough instructions on the essential principles of the car's construction and operation should be given by every dealer to every purchaser.

But this matter of Service, so important to the owners of the motor car business, is strangely neglected. The dealers who do make an effort to serve their customers, after the name is "on the dotted line" have made such hits with the public, I never could understand why more did not follow suit. Service is the biggest factor in the retail automobile business.

Mr. Baker, however, need not bother to learn how to avoid stripping gears. The car of the immediate and most imminent future will have none; and it will be steam driven. This is a prophecy and a prediction we are willing to put our money on.

H. T. HARRISON.

Grand Rapids, Mich.

Preserving Wood with Turpentine

To the Editor of the SCIENTIFIC AMERICAN:

I have seen in one of our papers that the SCIENTIFIC AMERICAN published an article inducing the world to discover a remedy to preserve wood from destructive worms.

Having succeeded in inventing a good remedy to preserve wood, I beg you to publish my discovery. Wood may be preserved from such destruction by treating it with pure turpentine; that is to say, injecting the liquid in the wood through a syringe or any other instrument. When the wood has not yet been attacked the medicament may be applied at the end of the pieces which should be placed vertically so that the liquid will penetrate them lengthwise.

I only wish to do a service to the world, thinking that said service is worth a fortune.

FADLALA SAYEG.

Beyrouth, Syria.

Happy Termination of the Shackleton Expedition

WITH the arrival at Punta Arenas, on September 3rd, of Sir Ernest Shackleton and the twenty-two members of his expedition who had been marooned on Elephant Island since April 24th with five weeks' rations and two seals, the gallant Lieutenant has finally closed out his current Antarctic account with the greatest credit to himself and all his men. While the scientific results of his expedition are far from what he had hoped for, there has seldom or never been written a more exciting chapter in the long tale of circumpolar adventure.

From the moment when the "Endurance" entered the Antarctic region in 1914 the most extraordinary obstacles of wind and ice were encountered, which culminated in the total loss of the ship on October 27, 1915. This catastrophe left the party with no alternative to a six months' drive in open boats with shortage of fuel; and upon arrival at Elephant Island in April, 1916, there followed the thrilling dash by Shackleton and five volunteers across 750 miles of sea to South Georgia. Arriving safely, in the face of all probabilities, after twenty-seven days, Shackleton at once exerted every effort to get relief to the main body of the expedition on Elephant Island.

Not daring to wait for the arrival of a really serviceable vessel, he was forced to make the attempt at rescue in such craft as were available. Three times during May, June and July he set out for the south—once in an eighty-ton privately owned whaler, once in a steam trawler lent by the government of Uruguay, and again in a seventy-ton wooden schooner secured from British residents of Chile; and three times formidable ice barriers forced him to return without success.

On August 26th, however, he tried once more, and, profiting by the previous failures, he found a practicable route this time, over which he was able to reach his goal in four days, and to return at once with the entire body of castaways.

Too much credit cannot be given to all concerned in this episode—to Shackleton for the bulldog determination which led him to go out again and again in pursuit of the smallest chance of success, to the men left so long alone on the island for the admirable manner in which they maintained themselves, deprived of such a leader. Although hampered by severe gales, intense cold and constant snow, they succeeded in supplementing their meager food supply and in setting up a satisfactory shelter under their overturned boats. The entire Shackleton expedition, in fact, may stand as a monument to human courage and endurance.

Ten Thousand Dollars for a Hand

IN connection with the accounts which we have carried from time to time of the extraordinary success of French surgeons in relieving severely mutilated soldiers of their disabilities by supplying them with artificial members, it is of interest to note that a prize of ten thousand dollars has been offered by an anonymous Frenchman for the most efficient artificial hand.

The competition, open only to citizens of the Allied countries or neutral states, will remain open for two years after the end of the war. Full particulars may be had by addressing M. le Secretaire-General de la Societe de Chirurgie, 12 Rue de Seine, Paris.

An Unparalleled Salvage Undertaking

Floating a Wrecked Vessel on Her Side

By Robert G. Skerrett

THE most ambitious salvage undertaking yet essayed is that now in progress in an effort to refloat the sunken freighter "Washingtonian," formerly of the American-Hawaiian Line. We say formerly, because all claims to the vessel have lately been renounced by her quondam owners in the belief that the craft is a hopeless loss. There is nothing in the annals of successful marine wrecking ventures that reasonably approximates the salvage problem presented by the "Washingtonian," lying as she does in the neighborhood of 15 miles off shore in the open sea and 90 feet down below the surface at mean low tide. Nevertheless, engineering courage has not been daunted, and men of skill are giving their best efforts to a technical gamble that will make salvage history if success reward their labors.

On the 20th of January, 1915, the "Washingtonian," laden with sugar from Hawaii, was nearing the Capes of the Delaware, bound for Philadelphia, when she was struck by a big five-masted schooner, during a heavy fog, and sent to the bottom in the brief span of 10 minutes. The invading sea saturated the upper mass of the sugar, shifted the ship's center of gravity, and caused her to turn turtle. As subsequently determined by Government divers, the freighter settled upon the seabed, over on her starboard side, and with a heel of substantially 75 degrees. This posture, in itself, would have added to the difficulties of refloating the vessel had she gone down in sheltered waters; and salvors with the usual equipment would probably have hesitated a long time before trying to raise the craft from a depth of 90 feet. The accepted order of procedure, in substantially landlocked waters, would have involved the use of pontoons to get the vessel on an even keel and then to raise her so that she could be pumped out. Considering the size of the "Washingtonian," a ship nearly 408 feet long and of 6,650 gross tons, it was realized by the would-be salvors that her bulk and weight stood in the way of utilizing pontoons. This was especially evident in view of the depth of submergence, the difficulty of making properly fast to the vessel, her position seaward, and the time that would be required to get her up and to move her shoreward.

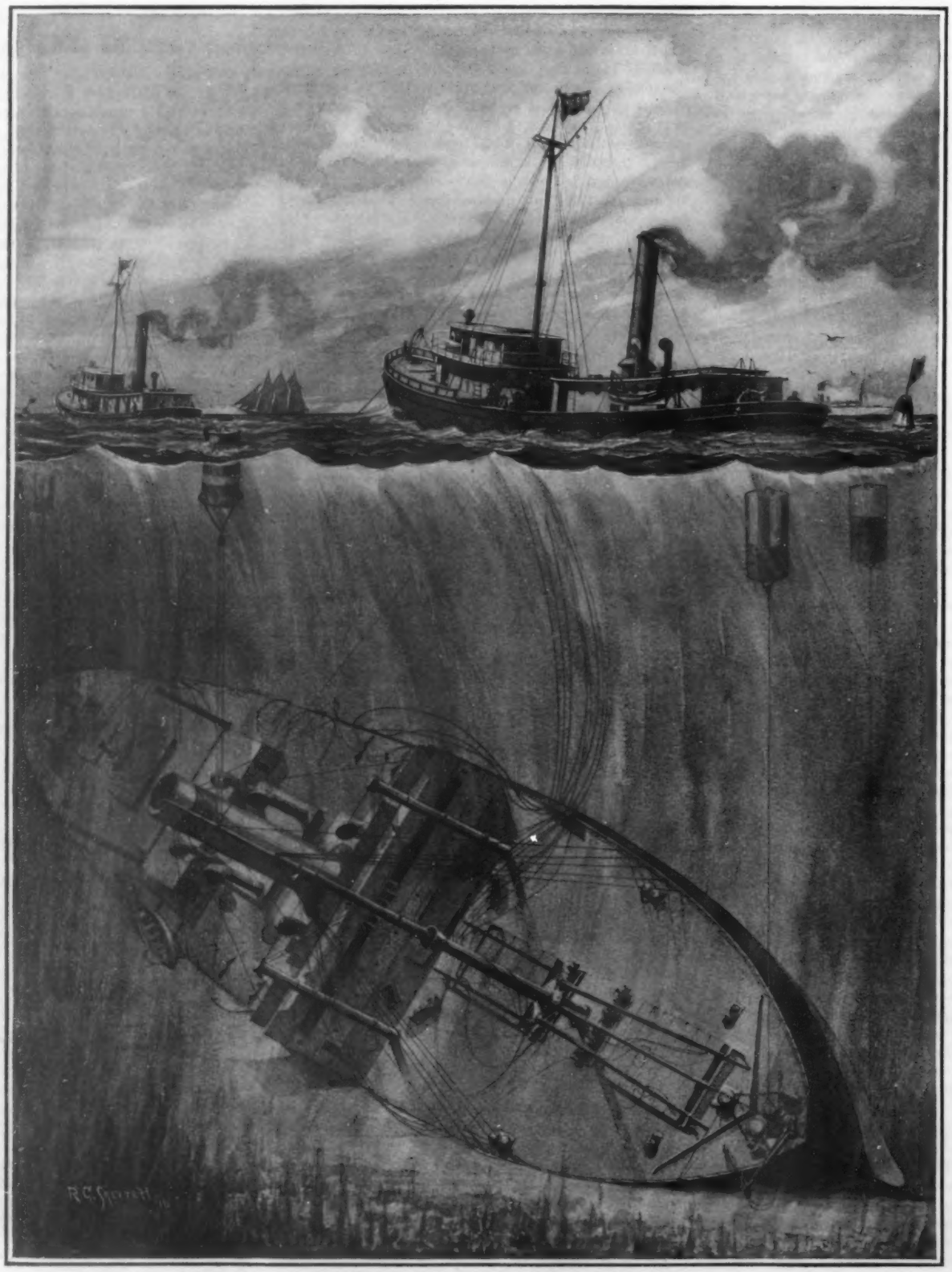
It was apparent to the engineers concerned that the "Washingtonian," to be successfully salved, would have to be brought directly to the surface by a single short operation when once her refloating was started, and that the next thing would be to tow her with all possible speed to the shelter of Delaware Bay. In other words, that only a few minutes should be needed to break contact with the bottom and raise the vessel, and once at the surface she should be towed the same day inside the Capes!

It was decided to have recourse to compressed air, but to use this buoyant medium in a decidedly novel fashion. A ship cannot withstand the bursting impulse of air held within her unless her decks are heavily reinforced and tied together so as to endure the stress. Manifestly, this laborious work could not be done by divers toiling so deep and exposed to the fitfulness of the open sea. Weeks and weeks of intermittent efforts, and those dangerous and heavy, would be required to get the materials down into the ship and properly placed. How, then, have the Wells Engineering Company overcome these many staggering obstacles and yet found ways to use compressed air? Here is where the chance posture of the ship has proved a possible aid and not an added handicap in salvage operation.

The "Washingtonian" is built upon what is technically known as the Isherwood system of construction, and because of this she is exceptionally strong in some particulars and able to withstand the bursting force of pent-up air between decks when that air is pocketed so as to bear against only limited areas of the decks. This can best be realized by reference to the accompanying diagram. But first, let us keep in mind that the ship has vents extending to her upper or shelter deck, and it is to these pipes that hose will be attached reaching thence to the surface craft and their air supplies. These vents lead directly to the several compartments, interdeck spaces, and the various tanks. Therefore, it is entirely practicable to distribute the air to the particular points desired.

The vessel's posture on the seabed is called her "first position," and the object of the salvors is to bring her to the second position with her mast horizontal and her sound or port side uppermost. The purpose of this is to increase the initial air pocket so that it will be nearly rectangular and, therefore, capable of holding a larger measure of buoyancy. At the same time, it is necessary to control the craft so that she shall not turn bottom upward. How will all this be done? To begin, air will first be blown into the double bottom tanks and into what is known as the deep tank—the latter being situated in the hold of the freighter and just forward of the boiler space. It was used as a stowage place for fuel oil. With air in her double bottom and deep tank, there will be enough buoyancy to break the ship away from contact with the seabed and possibly to start a turning movement tending to bring her bottom uppermost. This, however, will hardly suffice to refloat the craft, and therefore air will have to be admitted to the space between the decks and the upturned side—the lower limit being the top edge of the cargo hatch. The vessel will be prevented from turning bottomside up by an ingenious expedient.

The "Washingtonian" lost her mainmast at the time of the collision but her foremast is still standing. By an adjustable purchase, the outer end of this mast will be buoyed to a control tank having a total lifting capacity of some scores of tons. The mast will thus form a great lever. The tank will serve to hold the mast up at the pivotal point



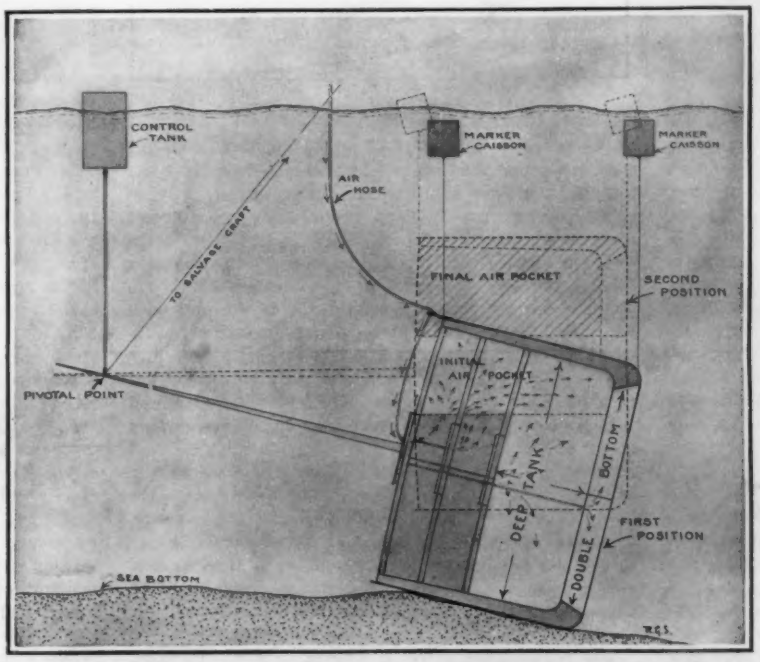
The "Washingtonian" lying at an angle of seventy-five degrees

of attachment, and in this way arrest any excessive upsetting motion on the part of the craft's body. This control is made more positive by leading the end of the control purchase to a winch aboard one of the salvage steamers. In this way the mast can be raised or lowered at will. At each end of the ship are two marker caissons, moored just below the surface. As the freighter starts to rise these caissons will indicate the degree of the movement and whether the bow or the stern or the keel tends to come uppermost. It is very important that the refloating be under nice control and that the vessel be brought up with her port side just level with the surface.

The air connections from both salvage steamers are led down to two widely separated stations at which are attached two frames with intermediate connections. That is to say, the air pipes from the surface will be joined to these connections at the rail as are also the second sections of the air feeds leading thence to the deck vents. The purpose of this is to simplify the task of insulation and to prevent any mistake on the part of the divers. There are two sizes of hose and the connecting lengths leading from the frames to the deck taps are just long enough in each case to reach a certain point, and where two lines are of the same length they are of different calibers and, therefore, cannot be improperly attached. The divers will first make the connections between the rail frames and the vents, and with these in place then the sections of hose leading to the surface vessels will be joined. There are duplicate frames on the salvage steamers, and in this manner it will be possible to know just where the air is going when it is sent down into the "Washingtonian."

As soon as she is brought to the surface, the "Washingtonian" will be towed as speedily as possible to the sheltered and shallow waters inside of the Delaware Capes where she will be grounded. Her righting will then be a comparatively easy matter. With this done the freighter will be pumped out and refloated and her wound repaired temporarily. Pumping out will, of course, admit air between decks while there is water above them, but as the decks are designed to withstand a heavy load, though not able to resist a bursting pressure from within, no risk will be run in this operation. Of course, this procedure could not be adopted with the vessel lying 90 feet down, because then the overload of water would immediately crush the deck inward.

The situation that has inspired the present salvage exploit is directly due to the war: the scarcity of ships and the high freight rates. When the "Washingtonian" was sunk, independently of her cargo, the vessel was valued at substantially $750,000. To-day, if afloat, and ready for service, she would easily bring $2,000,000! This is inducement enough to attract the present salvors and to win the powerful coöperation of the capital involved. As an engineering feat it is well worth the effort, and even if the result be unsuccessful still there will be a technical gain and the art will be much richer for the rare experience.



How the "Washingtonian" will be refloated without righting her until she has been towed into shallow water

Logistics

By George C. Thorpe, Major, M. C.

THE twentieth century heralds a new science—the business of war preparation: Like other sciences, its elements are not new; they have made a near-science for a hundred years or more, but only now is the vast importance of their unification—one might almost say their imperialization—becoming a reality.

Briefly to indicate its place, we must recall that war involves three divisions of labor: Strategy, Tactics, and Logistics. The first is the planning department; the second the objective execution; the third the business department.

The business of warfare provides the means of fighting; hence it operates from the beginning to the end; during peace as well as in war; from the very formation of the nation's fighting forces to—the time when there shall be no war. It provides the uniform for the new-found recruit, builds the ship that will go into the fleet, maintains all the fighting forces throughout their existence, takes care of the wounded during battle, and clears the battlefield of dead and prisoners at the end. In short, it is all there is of war except the plans of Strategy and the actual employment of Tactics.

One might ask why this should be reckoned a modern science. There have been only about 250 years of peace during the past thirty-four centuries, and certainly every one of the eight thousand wars that have been fought during that period have required the means of fighting. Why, then, has not logistics been always operative?

Its elements have been employed from first to last, and in a steadily increasing extent; the progress of war has been almost entirely the progress of logistics. The earliest battles involved little else than tactics; not being planned in advance, there was no strategy; as the fight was on a small scale, it was soon over, and so did not require measures for supply, transportation, elaborate communications, etc., that we now classify as logistical features. When, in the early stages of history, strategy began to find its place in warfare, operations became more complicated; then the issue depended upon the results of more than one battle; the contest was prolonged; arrangements had to be made for the food supply. Furthermore, strategy introduced strategems which involved preparation of traps, hiding-places, some arrangement for communications and for getting information; thus logistics gets its first importance from strategy. The modernization of the elements of logistics consists in their unification into a science.

Such unification is not merely an academic consideration, but a matter of great practical importance. Omission in this respect was responsible for the failure of Napoleon's Russian campaign. He had made elaborate preparations; the French armies set out with generous provision for everything in the shape of *means;* almost too much transportation, possibly too large staffs, and at the front troops at times had such quantities of food that they trampled it under foot. But wagons were used for improper purposes; wagons and river-boats were not brought to the proper places in time to distribute food supplies; means were not prearranged for reducing grains to flour; the subsistence department did not confer with the engineers to insure the preparation of roads for the supply trains; there was not such coördination between the tactical staffs and hospital corps as to obtain proper attention to the wounded after battle; the relation between the functions of getting information about the enemy and communicating it in usable form to the commander was not so established that the commander could take advantage of contacts with the enemy. The history of this campaign shows that, while Napoleon's strategy and tactics were excellent, there was no coördination between the functions of providing the *means* of fighting. The situation was reversed with the Russians: they had little or no plan, but their leader, Barclay de Tolly, had genius for organization.

To-day, either before or at the outbreak of war, the General Staff outlines the probabilities of the campaign in an "estimate of the situation," which is the basis for the issuance of orders. These orders, in turn, are notification to all the departments interested in providing *means* of what will be expected of them; in order to respond efficiently to this responsibility, without duplication, waste or omission, they must jointly estimate the business part of the situation; the division of labor will be determined, in the main, by the organization that would have been made previously, but even so there is much call for conference and coördination in the practical execution. For instance, transportation department cannot know how much transportation will be required until several of the other departments, such as subsistence, hospital corps, and supply departments in general, are heard from. On the other hand, if transportation facilities are limited, the supply departments must arrange their shipments accordingly, providing what shall go first, etc.

No two wars have been sufficiently similar, in the development of situations and means of meeting them, to permit anything like accurate estimates of requirements being made in advance. But timely estimates, based on the best data obtainable, surely promise better preparation than no scientific estimate at all. The business outlook of a possible or probable war can be viewed correctly only by a comprehensive estimate from all angles. There is the same utility in coördinating the elements of logistics under one head as there is in having a board of directors to estimate the business situations of a corporation.

The Current Supplement

A PARTICULARLY interesting article that will be found in the current issue of the Scientific American Supplement, No. 2124, for September 16, is *The Metabolism of Insects*, which tells of the successive changes undergone during their post-embrionic lives. An absolute essential to both attack and defense in the war methods of to-day, is the heavy artillery that is being used extensively by both sides. *The Big Guns of the War* summarizes many facts concerning these surprising weapons, and is accompanied by a number of illustrations. *Magic Pictures* is another illustrated article that describes a number of easily performed and attractive experiments that will furnish amusement for a winter evening. The explanatory photographs are excellent. *The Decay of Metals* discusses certain changes in character that are liable to occur in several materials. The paper on *Internal Combustion Engine Cycles* is concluded. *The Pallograph* describes an ingenious instrument that records both horizontal and vertical vibrations, and which is of great value in investigations of many kinds, particularly those relating to ships. *Unstable States in Arc and Glow Lamps* discusses a number of interesting phenomenon in a concise and readable manner. *The History of the Safety Lamp* sums up the efforts of a hundred years, and describes many of the devices that have been introduced to supply light to miners. There are also a number of shorter papers.

Cement Posts for Austrian Hop Gardens

EXPERIMENTS now being carried on in Germany, if successful, may create a market in the Carlsbad district for an American product. It is proposed to use cement posts in hop gardens for carrying the wires on which the vines grow. Wooden (pine or fir) poles are now used. They are about 8 feet long and cost 80 cents each. They are treated with a preservative to prevent rot, and their average life is 12 to 15 years.

If these experiments are successful, there will be a field in the Carlsbad district for the placing of cement machines. Its extent is indicated in the fact that in normal times, in the Saaz district, there is a hop acreage of 30,000, and it is calculated that with the present system of wooden poles, 210 poles are needed to the acre. With the use of concrete probably not so many poles would be needed.

The wire now used costs 8.7 cents per pound, a 24 per cent increase over the price before the war. It is estimated that the poles and wires installed in the hop gardens of the Saaz district represent an investment of more than $3,000,000.

Use of Hypochlorite of Magnesium as an Antiseptic

REGARDING the use of hypochlorite of magnesium as an antiseptic for surgical use, it appears that since the war the value of hypochlorite compounds is being fully recognized, and they are now taking the place which they deserve on account of their well marked antiseptic properties. The principal salt used for this purpose is hypochlorite of sodium, but as its solutions are somewhat caustic on account of their alkaline nature, it would be an advantage, as Dr. Chas. Mayer points out, to replace this by the hypochlorite of magnesium. This salt is very easy to obtain in solution such as is well adapted for the treatment of wounds, by mixing two separate solutions; first, a solution of 100 parts by weight of chloride of calcium in 2,000 parts water, and second, a solution of 190 parts sulphate of magnesium in 2,000 parts water. Mix the solutions and allow the precipitate to settle, then decant off the clear liquid, and this latter is then ready to be used as an antiseptic solution for surgical purposes. It has the advantage of not being at all caustic and so can be employed in a very concentrated solution. We would remark that this solution has now entered the trade here, and surgeons express themselves as very well satisfied with it, especially as the magnesium salt is found to be favorable to the defense and repair of infected wounds.

Curious Hygrometers and Barometers

Home Made Devices that Tell the Weather

By S. Leonard Bastin

IT is well known that when an absorbent material is immersed in a certain solution it changes color according to the amount of moisture in the atmosphere. Two or three of these solutions are available and by making use of them a picture that tells the weather may be formed. The following articles are necessary for the formation of the pictorial hygrometer. A stout piece of cardboard, a sheet of white blotting paper, a small amount of strong paste and a paint brush. The solutions mentioned below must also be prepared; these could be secured from any chemist, and only a very small quantity of each would be needful. The proportions are on the following lines:

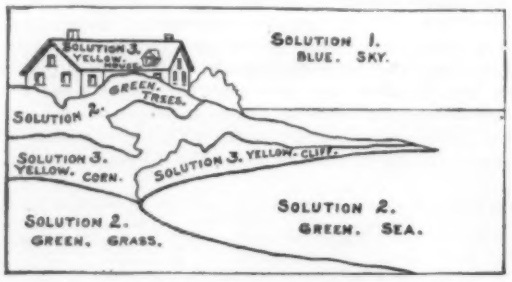
Solution 1.	Cobalt chloride	1 part.
	Gelatin	10 parts.
	Water	100 parts.
Solution 2.	Cobalt chloride	1 part.
	Gelatin	20 parts.
	Nickel oxide	75 parts.
	Cupric chloride	25 parts.
	Water	200 parts.
Solution 3.	Cupric chloride	1 part.
	Gelatin	10 parts.
	Water	100 parts.

The three bottles should be well stoppered and placed aside until required for use.

The first step is to sketch out the picture on the sheet of blotting paper using a fairly soft, though very black pencil. There is no need of putting in a lot of detail, but it is important that the outlines should be very strongly worked in. A suggested picture might be one in which a farmhouse is introduced, with fields of corn, and also pasture land hedges and trees. If it is possible to work in a lake, or a piece of the seashore, so much the better. When the picture is complete we may start to cut out the different sections. This should be done very cleanly, so that the various parts may be fitted together again after the manner of a puzzle picture. Actually the object of cutting out the picture in this way is to prevent spreading of the solutions from one part to another; of course it is important that each section should be colored with only one mixture.

The next step is to mount the picture on the piece of cardboard, and for this purpose do not use more of the paste than is sufficient to hold the different sections firmly in position. See that they fit well together, and when the picture is complete press the whole thing for twenty-four hours. It will now be time to apply the solutions. In a picture on the lines of that shown in the accompanying engraving this is how to set about the business. Here it is seen that the house is treated with Solution 3, and the patches of corn and the cliff are dealt with in the same manner. Solution 2 is employed for spreading over the trees and fields, and the sea and sky are treated with Solution 1. Shake the bottles while using the solutions, and do not take up too much in the brush at a time or there will be a danger of the mixtures "running" from one part of the design to another.

When the whole of the picture has been treated it will appear more or less pink in shade in all parts. In this form it will, of course, have a very muddled appearance. To test the weather picture hold it at a short distance from a heated surface. It will be noticed that the picture comes up in its proper colors. Thus the corn fields are yellow, the trees are green, and the sky and sea are blue. Now this is just what happens in the picture when the atmosphere is dry, and the weather is likely to be fine. It is well to stand the picture away from any stove, and the more closely in contact with the open air the more reliable will the workings of the device be. When the atmosphere is very moist the whole picture appears to be indefinite, and of a more or less uniform tint. As the air becomes dry and when fine weather is likely the picture takes



Layout of picture that tells the weather

on its proper coloring. So that the picture looks all right when fine weather is coming, and all wrong when the conditions are going to be bad. Naturally a large variety of pictures might be worked out, and a desert scene would be very effective. Here the palm trees would be treated with solution 2, the sand with Solution 3, and the sky of course with Solution 1. If the pictures are framed they should not be covered with glass, as it is necessary to leave the surface fully exposed to the action of the atmosphere.

A very interesting weather teller may be formed out of a bunch of paper flowers which have been treated with a solution of cobalt chloride. The blossoms may be of any fancied design and size, but the different parts should be wired together to avoid the use of gum or glue. As at one stage of the treatment the flowers have to be soaked, it is well not to use an adhesive. Any kind of suitable paper may be employed but to secure the best effects this should be in three colors, white, pink and yellow. The last named should be employed particularly in the making of the foliage for the artificial flowers.

The cobalt solution No. 1 should be used. A small amount of the solution is poured into a saucer, and each bloom is dipped in the liquid. It is highly important to treat all parts of the blossoms and, where they are rather complicated, it may be needful to use a brush to paint on the solution. Two or three applications of the cobalt solutions should be made, and at the end of the treatment the specimens are hung up to dry. Of course the artificial foliage which has been made is dealt with in a similar way. After treatment it will be found that the flowers and foliage are of a more or less pink shade. After a few days they will be ready to be arranged in some suitable position where they can be observed.

When there is a great deal of moisture in the atmosphere the blossoms and the foliage appear in the following style. The white paper flowers are pale pink, the pink paper ones a very bright red, while the foliage is orange. The bouquet does not look at all as it should. But as soon as the atmosphere becomes drier, and fine weather is likely, the alteration is very marked. Thus the white paper flowers become a bright blue, the pink paper blossoms a fine purple, while, most remarkable of all, the foliage changes to green. Thus we may say that dry weather is coming when the leaves are their natural color, and the blossoms have assumed the shades indicated. Of course, if desired, the blossoms may be made of differently colored papers; one could form a flower with yellow paper for the center, pink for the middle row of petals, and white for the outermost row. In dry weather this blossom would appear with a green center border in a purple ring which, in turn, is enclosed in bright blue. It will be found that the more in touch with the outside atmosphere the better will be the workings of the weather bouquet. Near a stove, for instance, the atmosphere will always be in an artificially dry state and this may cause the flowers to assume their fine weather aspect. Indeed, one of the best ways of testing the weather bouquet is to hold it near a furnace, when, if all is in working order, the dry weather colors will be assumed.

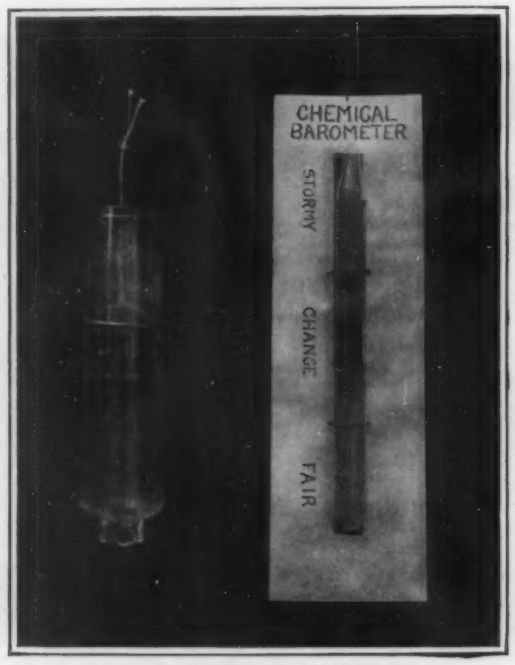
Another simple weather teller is formed of a weight and a piece of whipcord. The whipcord must be thoroughly dried at the start. Choose a position on a wall and, on to this, fix a card, across the center of which a line has been drawn. The position below the line is marked DRY, that above is lettered WET. Now take a weight, and suspend this with the whipcord. The adjustment should be carried out in moderate weather, and at this time the weight may be placed so that it exactly toes the line. When the air is damp, the weight rises above the line into the area marked WET on the card. When dry the reverse occurs.

An old fashioned device is known as the phial barometer. A long narrow four ounce bottle is used. The rim is cut off with a file. The bottle is then filled three parts with water and suspended upside down by means of a piece of looped string. During the turning over process a finger should be placed over the opening of the bottle. In fair weather it will be found that the water remains level with the opening of the bottle. As the atmosphere becomes damp the water starts very slowly to drop away from the phial.

The chemical barometer was invented by the meteorologist Admiral Fitzgerald. Into a long narrow bottle put two and a half drachms of camphor and eleven drachms of spirits of wine. In a separate vessel dissolve thirty-eight grains of saltpeter and the same

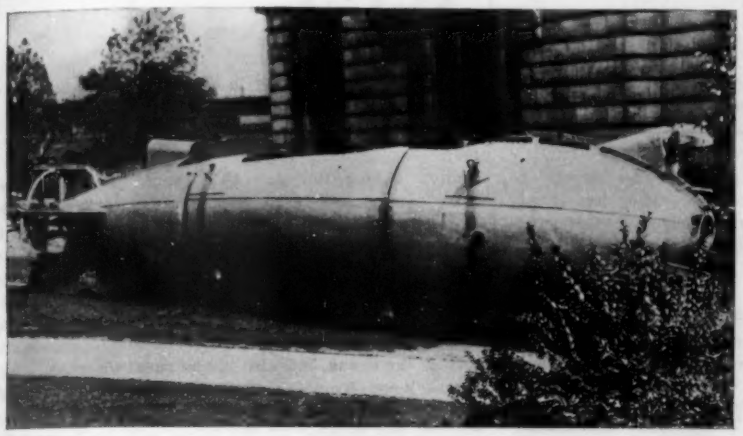
(*Concluded on page* 269)

A weatherwise frog

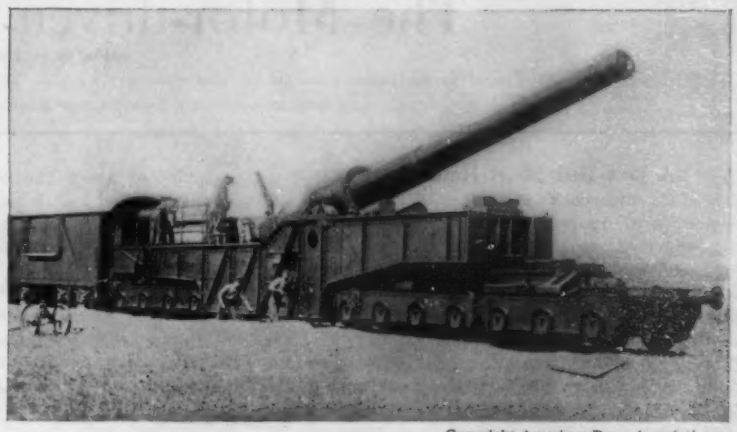


The chemical weather glass

A weather bouquet



THIS is the remains of an early American submarine constructed by Holland, recently purchased by Dr. P. J. Gibbons of New York City in order to save the historic relic from the junk pile. It will be noted that a part of the superstructure of this venerable craft has been removed; otherwise, it is still in fair state of preservation.



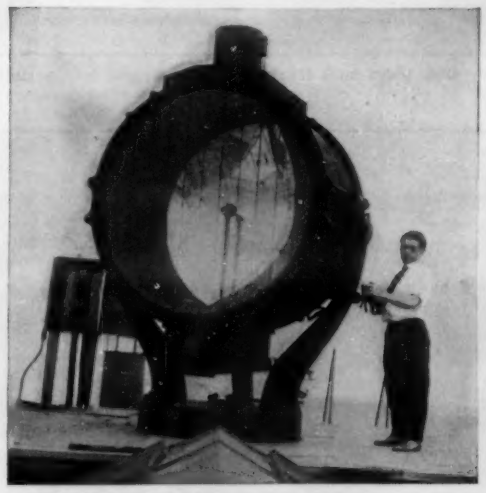
Copyright American Press Association

ONE of the huge guns used by the British in the Picardy battles. Mounted on a heavy railroad carriage, these 15-inch guns travel forward on specially-constructed railways. They fire a 1,700 pound shell to a distance of seven miles, at the rate of one shell per minute if necessary. Ranges are obtained by aerial observers.

PICTORIAL NOTES

Copyright Underwood & Underwood

IN order to rid Brooklyn and Queens of salt marsh mosquitoes, New York City is draining 8,000 acres of salt marshes bordering on Jamaica Bay. In the upper view appears one of the gasoline-operated ditching machines which are cutting numerous channels through the marshes. The lower view shows Commissioner of Health Haven Emerson studying at first hand the progress made in the vast and commendable undertaking against the malarial mosquito.

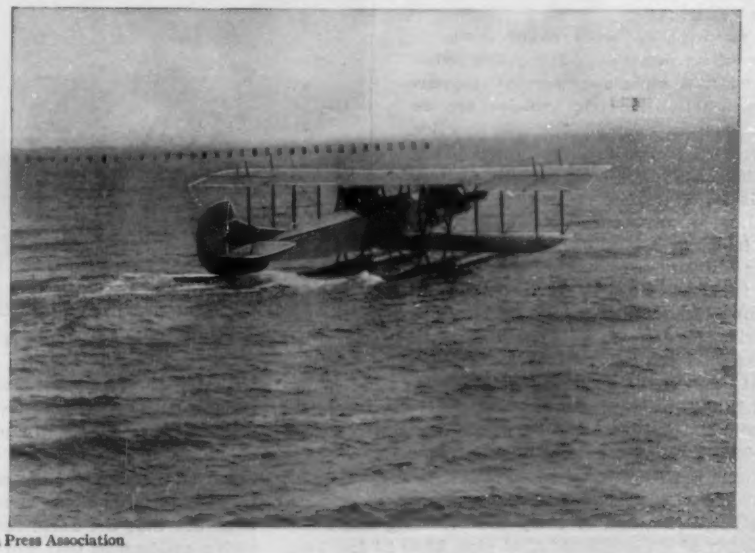


FOR experimental purposes only, Elmer A. Sperry, the well-known inventor of gyroscopic devices, has installed a 1,280,000,000 candlepower searchlight on the roof of his laboratory in Brooklyn, N. Y. The searchlight is said to be the most powerful in the world, exceeding by 60 per cent the one recently tried out at the Brooklyn Navy Yard, with which objects could be plainly seen 35 miles away, according to reports.

TO facilitate the flushing of city streets, a member of the fire department of Baker, Ore., has conceived the idea of constructing a flexible pipe mounted on small wheels and drawn about by a horse. It consists of canvas-coupled sections of three-inch pipe, each five or six feet long, mounted on little wheels placed under each section. In small communities where hydrants are not numerous and the hose is long, the idea lends itself admirably.

Copyright American Press Association

HERE is the new convertible Curtiss twin tractor machine which recently passed its tests and was accepted by the Navy. It is equipped with two 100-horsepower engines, and has a range of speed from 45 to 100 miles per hour. Of especial interest is the fact that the machine flies and climbs on one motor only, if desired. The fuselage is constructed to provide a wide and unobstructed range of vision for the observer or gunner, seated in the nose of this naval aeroplane.



PILOTED by Victor Carlstrom, the twin tractor "hydro-aero" went up 10,000 feet over Hampton Roads in 10 minutes and successfully passed the tests. The pilot made three consecutive flights in the machine, taking a naval officer as passenger on each flight. The machine made on an average a speed of 95 miles an hour for each flight; but the climbing ability is perhaps most interesting, since it is the predominating factor in the employment of seaplanes or hydroaeroplanes for naval work.

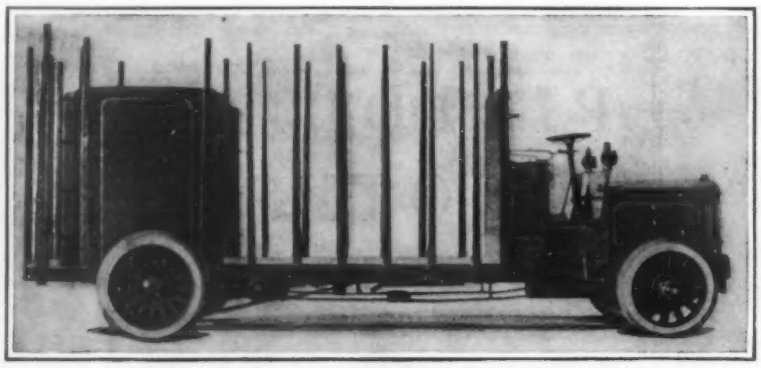
The Motor-driven Commercial Vehicle

Conducted by VICTOR W. PAGE, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

A Low-Bed Short-Haul Truck

ONE of the drawbacks to the use of motor trucks of conventional design in transporting heavy loads is in the height of the load carrying platform from the ground. A truck has been designed to facilitate the economical loading and movement of heavy commodities from docks and warehouses which embodies the characteristics of the low-bed horse-drawn vehicle. The truck may be loaded from either side or rear and removable stakes insure easy access to any part of the load. Of course, a truck of this nature is only intended for use under conditions where a large clearance between the axles and the ground is not necessary. The load is supported by springs which are underslung at the front end to permit of the low type of construction. As a chain drive is employed the rear axle may be dropped to attain the same end. The power plant is a four cylinder motor, 4¾" bore and 6¾" stroke. Power is transmitted through a multiple disk dry plate clutch and a three speed transmission. The wheel base is 178", the tread at the front is 68" and at the rear 96". The front tires are 36 x 6" single, while the rear wheels are provided with demountable 38 x 6" dual tires. The body is carried only 24" above the ground and has a floor or carrying platform 64" wide and 14 feet in length. The frame is composed of two I beams running full length which are trussed to increase their capacity and two channels on either side starting at the rear of the front spring. The truck will carry a load of six tons. It is claimed that the low type of construction which permits of lowering the center of gravity makes a material saving in tire expense because of the lessened skid load on the tires when turning corners.

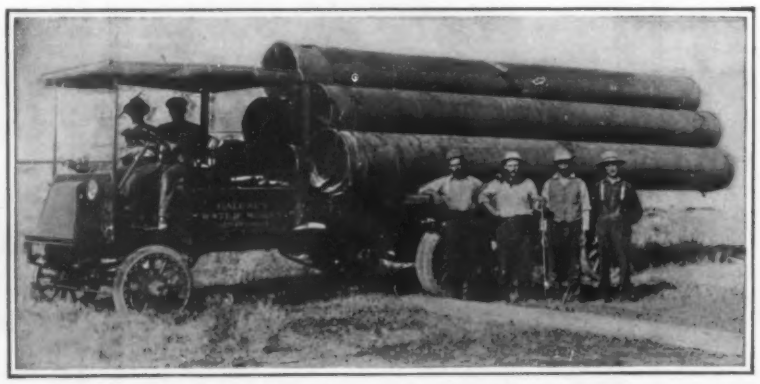


A low-bed, short-haul truck for heavy freight transportation

Electric Vehicles in Municipal Service

ONE often wonders why most of our city governments are so deliberate in adopting the proven and economical mechanical methods of moving loads that have been used by private individuals and corporations for many years. Vehicle transportation cost must be a big factor in the operating expense of any municipality, yet many of our cities of the first rank continue to use horses in such important departments as that of Street Cleaning and Public Works where motor transport is especially suitable. The worth of motor propelled fire apparatus is now well recognized and there is a gradual change to motor power in all fire departments where efficiency is a paramount issue.

A municipality needs motor trucks in many of its activities. For police patrol and hospital ambulance service they are indispensable. Electric vehicles are especially well adapted for city service. When used in the fire, police and public health departments, their rapidity of turnout is an advantage of moment and unequalled by any other form of traction. For instance, in an electric fire station under ordinary service conditions a turnout is often effected in less than 10 seconds. In street cleaning service two electric vehicles of the type illustrated make a daily saving over horses of as high as $24 when used for sprinkling nine hours, and flushing eight hours at night. During winter months, the tanks are removed and replaced by wagon boxes which hold 6 cubic yards of material. Another useful electric vehicle is the three-ton capacity truck used by a water works department. When used for moving water pipe, a trailer is attached to carry the overhang and loads consisting of six lengths of steel pipe, 20 to 24 feet long and 24 inches in diameter, weighing 6 tons, have been hauled more economically than any by other means. An electric truck has long life with low depreciation and does not need the skilled mechanical attention needed by other forms. Of course, its radius of action is limited to the battery charge, but in city work, this is enough to do three and four times the work of horse-drawn vehicles of about the same capacity. An electric is easily handled and is easy on tires. They are silent, clean and always ready for work provided proper charging facilities are available.



Electric truck used by a waterworks department

Electric vehicle used in street cleaning service

The Passing of the Horse

WHILE horses are still numerous in this country and are likely to be for a number of years there has been a diminution in the number of horses used abroad, due to the wastage of war. It has been stated that only 7 per cent of the traffic of the principal cities in England was carried on by means of commercial motors at the outbreak of the war. The consumption of draft animals in all of the belligerent countries has been great and is continuing at a rate that increases with the progress of the war. Animals that were in good condition for work when the war started and which were left in small numbers to serve requirements of civilian traffic are older than they were at the outbreak of the war and are not so suitable for the work they performed when younger and stronger. Indications are that the horse shortage will come to a head with a suddenness that will be unpleasant to those who have been depending entirely on animals.

The army horses that have not been sacrificed in war will have been subjected to work that will make them prematurely old and as they will be practically worn out, it cannot be expected that the horses released from war duties will be of any great value. Horse breeding has been practically at a standstill in England and France, during the past two years. Inasmuch as a horse cannot do effective and steady work until he is at least four years old there will be a gap between the war's consumption of animals and the release for commercial service of those that have been bred independent of military control. When the supply of horses fails it is evident that motor trucks and gas tractors must take their place and a large market will be created, not only in the towns, but also in the rural districts. While horses were doomed eventually and would have been eliminated in time by commercial vehicles and agrimotors, the passing of the horse will be hastened by a dearth of these animals because many will be forced even against their will to use the motor vehicle to do their work.

Great inroads have already been made upon the pre-war balance of 93 per cent of traffic remaining to the credit of the horse. Horses are gradually being eliminated from the principal thoroughfares because they are unable to keep up with the rapidly moving stream of motor vehicles and cannot be driven in traffic with the celerity that is absolutely necessary in these days. An interesting parallel is the elimination of sailing vessels by the faster and more profitable steamers. Just as there are thousands of sailing craft still in use there are thousands of horse owners that will keep their animal stock and horse-drawn vehicles as long as possible. Some of these men lack capital and cannot purchase the new equipment. Others have capital but lack enterprise. In any event the coming generation is being educated along mechanical lines and are readily grasping the principle that work can be better performed by machine than by animal power. A scarcity of horses will, of course, bring this point home much more forcibly than any other means at the conclusion of the war when business conditions become normal again.

Benjamin Day. Artist—Inventor

BENJAMIN DAY, who died on August 30th, at Summit, N. J., was the son of Benjamin H. Day, founder of the New York *Sun*. He was born in New York city in 1838. From the late 1860's to about 1880 he was an illustration artist doing work for the publications of Frank Leslie and the Harpers. He had studied art in Paris.

At that time, illustrations were made on wood, in wash and pencil, for engraving by hand. In the late '70s "process" engraving came into use for the reproduction of pen drawings in the form of metal printing plates. Ben Day was one of the first to take up pen-drawing on cardboard for this purpose. He had marked success in this line, and his studio at 48 Beekman St., New York, N. Y., became famous. There, about 1878, he invented the process for tinting drawings, known, afterward, throughout the world, as the "*Ben Day Rapid Shading Medium.*"

The principle of this invention is a transparent gelatin film, mounted upon a frame, the film being smooth on one side, with lines, stipples or textures in relief on the other. The relief side of the film is inked by a printer's gelatin roller, the film being supported by a cushioned pad invented for the purpose. The film, thus inked, is placed (inked side down) upon the drawing outlined on metal, stone, or cardboard, the drawing being visible through the transparent film. Pressure on the back of the film by a stylus, or rubber roller, transfers the inked pattern of the film upon the drawing where desired.

At first, all that was attempted by the inventor was the laying of "flat tints," but he soon saw that to obtain effects similar to those of wood-engraving, it would be necessary to achieve graduations of color in lines and textures. Toward this end, he invented a registering apparatus to hold the shading film in position and, at the same time, by means of a micrometric mechanism, within the same, make feasible the gradual shifting of

(*Concluded on page 269*)

THE MORE A MAN KNOWS ABOUT MOTOR CARS, THE MORE EAGER HE IS TO OWN A CADILLAC

WHEN a man becomes the owner of his first motor car, even an inferior product represents to him—for the time being—the acme of elegance and the height of enjoyment.

It is such an innovation that he feels almost as if he were living in a new world.

He revels in its achievements.

He excuses its faults and dismisses any forebodings which may arise in his mind—with the honest belief that it is a good car.

But, after a while, conditions change.

He makes observations; he contrasts his car with others which he might have owned—and the contrast disturbs him.

Now that the first enthusiasm of ownership has faded, he begins to feel that his car is not entirely befitting his station, and that it does not measure up to the standard of what he would like it to be.

He inquires into the merits of various cars—he traces their "ancestry."

And, as he becomes more familiar with motor cars in general, the greater becomes his desire to own a Cadillac.

He recognizes, in the Cadillac, the car that has been passing him on the roads and on the hills.

He recalls the testimony of shop men about the very few Cadillacs which come under their care.

And, ultimately, he graduates.

He becomes a Cadillac owner.

He lives over again the enthusiasm of his first days' motoring.

Driving a Cadillac is such an advance over his previous experience that, again, he feels as if he were in a new world.

It is a world of new beauty, and of fewer limitations.

Where, before, he felt restricted, he now feels the utmost freedom.

The fascination of driving, which had faded somewhat, returns with renewed charm.

He finds that his Cadillac possesses an abundance of reserve power, instantly at his command.

He finds that it does more of the things which he wants his car to do.

He finds that it runs more slowly on direct drive, and does so without expert manipulation.

He finds that it negotiates bad roads better, more easily, with less attention, and with greater comfort to himself and passengers.

He finds that it is much easier to handle and control, and that after a long drive, instead of being exhausted, he is rested and invigorated.

He finds that hills which—in the past—had compelled his car to strain and labor, now seem almost to melt away before him.

The thrill which attended the first "speeding up" was never so pronounced as that which surges through him as he feels the quick response of the Cadillac engine.

The confidence which, before, was buoyed up by the ***belief*** that his car was a "good" car, is now a permanent ***conviction*** that he owns a car which has made history, whose prestige is an asset, and whose performance is unapproached.

He is no longer merely a motor car owner.

He is a Cadillac owner.

Cadillac
Standard of the World

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

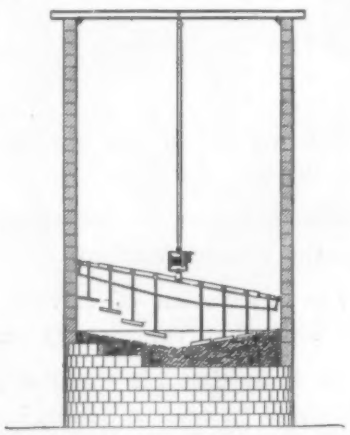
Pertaining to Apparel

SHOE.—G. CASHMORE, 2323 Alameda Ave., Alameda, Cal. In this case the invention relates to auxiliary fastening means for shoes. The object is to provide a shoe which has an auxiliary fastening means to be used in an emergency, when it is necessary to quickly remove the foot from the shoe.

SNAP BUTTON.—J. SILBERMAN, 69 E. 90th St., New York, N. Y. This invention relates particularly to what are known as snap buttons, and provides an arrangement whereby an effective article is produced at a minimum cost. It provides a construction where a number of parts are used and these formed so as to operate under all conditions.

Of General Interest

ENSILAGE PACKER.—W. J. WILSON and J. F. RUFF. Address the former, Box 67, Petersburg, Ind. This invention relates to means for packing ensilage in silos, and provides means which are simple in construction and easily manipulated, which enable two men to



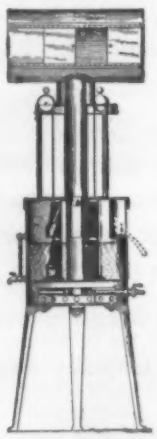
ENSILAGE PACKER

accomplish the same results now requiring five men, which packs the ensilage uniformly and thus improves the condition thereof and reduces loss through decay and by means of which the capacity of a given silo will be increased.

SELF-CLEANING LIQUID FILTER. — T. LINKE, 235 W. 46th St., N. Y., N. Y. The invention relates to liquid filters such as shown and described in the Letters Patent of the United States No. 1,149,926, formerly granted to Mr. Linke. The present invention provides a self-cleaning liquid filter, arranged to permit the owner of a filter to readily replace a worn out scraper blade by a new one without the aid of a skilled mechanic.

DESK.—C. H. BROWN. Address Lester B. Gum, 306-311 State National Bank Building, Oklahoma, Okla. In this desk a central support is provided, having a series of horizontal partitions, and mounted on rollers to permit the support to be moved in any direction, and wherein the support is provided with a series of shelves at sundry of the partitions extending laterally outward at angles of 90 deg. with respect to each other to permit either shelf to be used independently of all the others and to permit a number of persons to use the desk simultaneously, and wherein sundry of the shelves are provided with extensions.

STERILIZER.—G. PULLETS, 927 Freeman St., Bronx, New York, N. Y. Among the objects of the invention is to provide an apparatus of a simple, neat, relatively cheap and efficient character having facilities for insuring a thoroughly sterilized set of towels or implements for each customer for use in barber shops for cleansing and sterilizing towels and implements used in such shops. The apparatus is also for use by dentists and physicians in their practice; and in industrial establishments and hospitals.



STERILIZER

Hardware and Tools

MULTIPLE WRENCH.—L. KALINA, 384 Alabama Ave., Brooklyn, N. Y., N. Y. This wrench is arranged to provide a number of differently sized wrench heads, any one of which can be readily brought into position for engagement with a nut or similar article, whether the same is visible or not, and to allow of folding the wrench into a comparatively small bundle when not in use, thus rendering it exceedingly serviceable for the use of mechanics, drivers of automobiles and other persons.

Household Utilities

COMBINED MOP HEAD AND MOP WRINGER.—E. C. WORNS, 287 W. 127th St., New York, N. Y. This invention relates to mop heads having a front loop and a rear revoluble loop which, when revolved, serves to wring the mop. Mop heads of the indicated character include a presser frame carrying a front loop, and generally adjustable to vary its angular position relatively to the mop-handle.

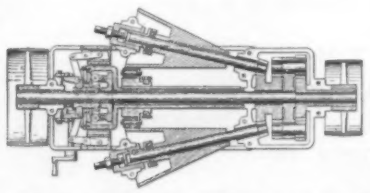
CHAIR FOR CLEANING WINDOWS.—J. STERNAD, 164 New York Ave., Jersey City, N. J. This invention relates to chairs for cleaning windows, and provides a simple, inexpensive and convenient chair whereby window-cleaning is rendered safe. Another object is to provide a chair for window cleaning which can be collapsed so that the same may be stored in a comparatively small space.

Machines and Mechanical Devices

FALLER ATTACHMENT FOR SPINNER FRAMES.—W. A. LUSH, 412 Clearview St., Scranton, Pa. This invention provides an improved attachment for a faller device, whereby the thread may be doubled and spun in one operation on the same machine. It provides an arrangement of faller device for breaking the remaining threads when one thread accidentally becomes broken.

TOOTHPICK VENDING MACHINE.—F. MESZAROS, 1571 Ave. A, New York, N. Y. This invention refers particularly to toothpick vending machines and provides an improved construction which will vend one toothpick at a time. It provides a construction for vending toothpicks which will vend a certain quantity

VARIABLE-SPEED TRANSMISSION MECHANISM.—S. P. WHITESIDE, Box 585, Baltimore, Md. An object here is to provide transmission mechanism wherethrough power can be transmitted at variable speeds, the range of which speeds is wider than could be



VARIABLE-SPEED TRANSMISSION MECHANISM

obtained through a frictional, variable-speed device with members of definite proportions. It provides a variable-speed transmission mechanism in which planetary gearing is utilized to increase the power of a frictional variable-speed device by reducing the range of speeds thereof.

CUP PACKING EXPANDER.—I. R. SMITH, address J. S. Williams, care of Williams Photo Co., Hastings, Neb. The invention provides an automatic, mechanical expounder for packings, whereby an even pressure is maintained between said packing cups and the walls of the pump cylinder, thus insuring a maximum efficiency thereto and insuring long life thereto by reason of the fact that it is impossible for the sides of the packing to wrinkle, crumble or collapse, irrespective of the thickness thereof, even when worn very thin by long use.

AUTOMATIC TAPE STRIP PRINTING AND DISPENSING DEVICE.—S. NAGER, JR., care of Burrows Metal Mfg. Co., 521 W. 23d St., New York, N. Y. This invention relates to a device for printing, moistening and cutting automatically strips of tape unwound from a gummed roll of tape. It provides an automatic machine which is neat in appearance, which is easy to manipulate and in which rolls of gummed tape can be easily and quickly interchanged.

REFRIGERATING MACHINE. — W. S. STAIR, 137 Joralemon St., Brooklyn, N. Y., N. Y. This improvement pertains to refrigerating machines of the rotary type; and has reference more particularly to the inclosed rotary type of machine in which the refrigerating medium and the lubricating medium adapted to mix and are separated by the centrifugal force generated by the machine.

Railways and Their Accessories

ELECTRIC TRAIN STOP SYSTEM.—THEO. W. VICKERS, Ontario, Cal. This invention improves and simplifies the design and installation of a train-stop system so as to be entirely automatic in operation, whereby a train when within the danger zone of a train ahead will be stopped if the engineer fails to observe the condition of the signal or stop devices, so that collisions are positively prevented.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

LEGAL NOTICES

Classified Advertisements

Advertising in this column is 75 cents a line. No less than four nor more than 12 lines accepted. Count seven words to the line. All orders must be accompanied by a remittance.

SITUATIONS WANTED

CHIEF CHEMIST—EXPERIENCED in chemical research, mechanical design and scientific management, is open for engagement as chief chemist, superintendent, or in sales department. E. J. B., P. O. Box 2, Grand Central Station, New York City.

TECHNICAL BOOKS

FIFTEEN BOOKS ON TRACTOR ENGINEERING and Tractor Farming, written by experts and published by the largest company of exclusive tractor builders in the world. Sent on three days free approval. No money to pay until you see the books and decide that you want them. This is a complete correspondence school. Price for the set, $3.50 or 25c for each book. Master these books and you can run a tractor. Jobs are waiting everywhere for expert tractor engineers. Send name and address. Hart-Parr Co., Box O, Charles City, Iowa.

WELDING

A WONDERFUL DISCOVERY. New welding compound for aluminum, aero metal, etc. SO-LUMINUM saves parts heretofore scrapped. Perfect substitute for acetylene welding—one-half time and cost. No flux required—use gasoline torch. Sample bar, $1.00; per lb. $3.50. Dept. "A." So-Luminum Repair Shops, 126 Nassau Street, Brooklyn. Address So-Luminum Mfg. Co., 1790 Broadway, New York. Telephone 8420 Columbus.

Curious Hygrometers and Barometers

(*Concluded from page 264*)

amount of sal ammoniac in nine drachms of water. When the salts are dissolved add this solution to the camphorated spirit, shaking the two well together. Now put a cork in the bottle and close with sealing wax, finally making a small hole with a red hot needle through the top. Another way is to put the mixture in a narrow glass tube, the open end of which is drawn out to a point; while the glass is in a soft condition a small hole is made with a needle.

Leeches are astonishingly sensitive to weather change. Fill a jar with pure water and cover the opening with muslin after placing the leech inside. During fine weather the leech lies motionless at the bottom of the jar. When rain is coming it climbs to the upper part and seems generally unsettled. At the coming of wind or thunder it shows extraordinary activity, moving rapidly about and scarcely staying in one place for ten seconds. The same kind of jar may be used for a frog barometer. In this case a small wooden ladder of three or four steps should be used, and the water in the jar should not come beyond the third rung. When the weather is likely to be fine and dry the frog remains below the water most of its time. At the approach of rain it climbs up the ladder and sits right out of the water. As the weather tends to become finer it returns to the water. In both barometers change the water once a week.

Benjamin Day. Artist—Inventor

(*Concluded from page 266*)

the printing film over the drawing in order that successive prints might be made exactly where wanted, thus increasing the color of the first "lay" by repeated movements to any degree desired. The drawing, thus made, was afterward reproduced in plate form by the process of photo-engraving. In the early days, the plates, by a circuitous method, were cast in type-metal. To-day the method of photo-plate reproduction is different. The mediums are also worked direct upon zinc or copper plates, these being etched into printing plates. In 1905 Mr. Day invented a special apparatus for the use of the shading mediums on lithographic work, in which field the mediums are widely used throughout the world. Other mechanisms, for the particular use of his inventions, followed, among which was the *Ben Day Tubular Roller* for inking the mediums. The point of this invention lies in having a roller of gelatin composition cast in separate, hollow cylindrical form, instead of directly upon a cord-bound core. This hollow roller is slipped on a core of brass tubing mounted within a light aluminum frame, instead of a heavy iron one. The advantage of the hollow roller lies in its freedom to shrink or expand upon the core according to climatic conditions, thus guaranteeing a constant even plane for the roller. Printer's rollers, as made for the general trade are cast directly upon a wooden stock, meshed with twine, which latter holds the roller embedded as part of the stock. Denied the contractile freedom mentioned above, the tendency of the roller surface is to "dish," thus rendering the inking line untrue. The Day invention overcame this objection.

Trees Planted by Machine

THE United States Forestry Service has adopted a new invention which plants from 10,000 to 15,000 forest tree seedlings a day. Previously the planting has been done by hand at the rate of 1,200 to 1,500 trees each day per man.

The machine is about the size of an ordinary mowing machine, and is operated by three men and two horses. One man drives the team while the other two handle the seedlings. The machine makes a furrow, in which the trees are set at any desired distance, and an automatic device indicates where they should be dropped. Two metal-tired wheels push and roll the dirt firmly down around the roots.

NEW BOOKS, ETC.

THE AMERICAN FERTILIZER HANDBOOK. 1916. Philadelphia: Ware Bros. Company. 8vo. Price, $1.

The compilers of this well-known annual believe that it will answer any reasonable inquiry concerning the fertilizer trade. The special articles and statistics that precede the several directories express the most recent views of authorities and present valuable information in a concise manner. There are four directories; that of the fertilizer manufacturers of the country is arranged by States, and is keyed to indicate the exact nature of their business; a classified list of the allied trades includes manufacturers of machinery and equipment, of materials and supplies, together with brokers, importers and exporters, chemists, phosphate miners, sulphuric acid plants, and lead burners; this is followed by the cottonseed oil mills, arranged by States; finally we have a directory of packers and renderers, keyed to show the specific activities of each firm. The convenient arrangement of all information is a noteworthy feature of the handbook, and all who are in any way interested in the fertilizer industry will appreciate this accessibility of material.

INDUSTRIAL ARITHMETIC. An elementary Text for Boys in Industrial, Technical, Vocational and Trades Schools, Both Day and Evening. By Nelson L. Roray. Philadelphia: P. Blakiston's Son & Co., 1916. 8vo.; 154 pp.; 86 illustrations. Price, 75 cents net.

The mathematical knowledge needed in the first-year shop course of the industrial high school is here reviewed, and its practical uses are instilled into the mind of the student; the problems of school shops are given, and their application to the tasks which may later be encountered in actual work is indicated; the idea of general positive number is introduced, with its use in formulæ and in simple equations, which prepares the approach to the course in algebra; in addition, the student who finds himself obliged to leave school at the termination of this first-year course will at least have become familiar with some of the practical applications of commonly used geometrical formulæ.

TABLES FROM THE MATHEMATICAL THEORY OF INVESTMENT. By Ernest Brown Skinner. New York: Ginn and Company. 8vo.; 242 pp. Price, 36 cents.

This set of tables, a reprint from Prof. Skinner's larger work, "The Mathematical Theory of Investment," offers twelve series of calculations, each applicable to some phase of investment, such as interest, time, present value, annuities, and mortality.

HOMANS' AUTOMOBILE HANDBOOK. The Gasoline Motor Car. By J. E. Homans. New York: Sully and Kleinteich, 1916. 8vo.; 248 pp.; illustrated. Price, $1 net.

Mr. Homans manages to pack an unusual amount of information into a comparatively small space, and at the same time he exercises his selective judgment to such advantage that nothing is included unless it distictly contributes to the automobilist's practical knowledge of his car, its management, its operation, and its care. Those chapters which deal with the engine go very thoroughly into principles and practice, with particular attention to lubrication, the adjustment of ignition and mixture, and the causes and symptoms of engine troubles.

A HANDBOOK OF AMERICAN PRIVATE SCHOOLS. 1916. Boston: Porter E. Sargent. 8vo.; 604 pp.; illustrated. Price, $2.

The conscientious parent, whether he has little or much to spend upon the education of his children, knows that, even among the better private schools, the value given for value received varies greatly, both in quantity and in quality. This handbook, issued annually and hence always to be depended upon for accurate information, lists and describes the boys' and girls' schools, the military schools, coeducational institutions, conservatories of music, art academies, and summer camps of the United States, with a section on the private schools of Canada. It is clearly indicated whether the institution is of the day or boarding class, and the head, the date of establishment, tuition fees, the number of the faculty, the length of course, and any special features are given, so that an excellent guide is provided for the intelligent exercise of selective judgment. Educational authorities, too, will find the work exceedingly useful. Each annual issue has been a distinct advance over the one preceding, and the present edition offers many new features; the new review of educational progress and recent literature is a noteworthy example.

THE PORTRAIT STUDIO. Size, Design, Equipment, and Management. By Practicus. London: Henry Greenwood & Co., Ltd., 1916. 12mo.; 40 pp.; illustrated. Price, 6d. net.

The amateur or the beginning professional may find this little handbook helpful in the selection or erection of his studio. Lighting has received a somewhat detailed consideration, suggestions for the furnishings are given, and there are chapters on portable light-controllers, backgrounds, and lenses for portraiture.

Any Scientific or Technical Book Published

can be secured through the

BOOK DEPARTMENT

OF THE

SCIENTIFIC AMERICAN

A 176 page catalogue and two supplementary lists of the latest publications, in which are listed and described over 4000 of the best books covering the various branches of the *ARTS, SCIENCES AND INDUSTRIES*

Sent free on request

MUNN & CO., Inc., Publishers

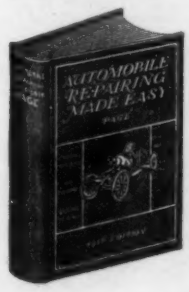
Woolworth Building **New York City**

JUST PUBLISHED!

The Most Needed and Useful Book on Automobiles Ever Written

Accurate! ***Authoritative!*** ***Distinctive!***

AUTOMOBILE REPAIRING MADE EASY



By VICTOR W. PAGE, M. E.

1000 Specially Made Engravings on 500 Plates
1056 Pages (5½x8). 10 Folding Plates

PRICE $3.00 POSTPAID

A COMPREHENSIVE, PRACTICAL EXPOSITION OF EVERY PHASE OF MODERN AUTOMOBILE REPAIRING PRACTICE

THE ONLY BOOK OF ITS KIND—IT FILLS A REAL DEMAND

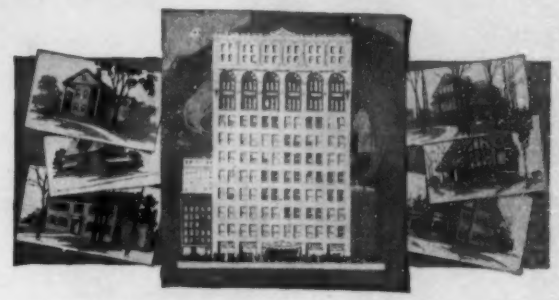
OUTLINES every process incidental to motor car restoration. Gives plans for workshop construction, suggestions for equipment, power needed, machinery and tools necessary to carry on business successfully. Tells how to overhaul and repair all parts of all automobiles. The information given is founded on practical experience, everything is explained so simply that motorists and students can acquire a full working knowledge of automobile repairing. Other works dealing with repairing cover only certain parts of the car—this work starts with the engine, then considers carburetion, ignition, cooling and lubrication systems. The clutch, change speed gearing and transmission system are considered in detail. Contains instructions for repairing all types of axles, steering gears and other chassis parts. Many tables, short cuts in figuring and rules of practice are given for the mechanic. Explains fully valve and magneto timing, "tuning" engines, systematic location of trouble, repair of ball and roller bearing, shop kinks, first aid to injured and a multitude of subjects of interest to all in the garage and repair business. All illustrations are especially made for this book, and are actual photographs or reproductions of engineering drawings.

THIS BOOK ALSO CONTAINS SPECIAL INSTRUCTIONS ON ELECTRIC STARTING, LIGHTING AND IGNITION SYSTEMS. THEIR REPAIRING AND REBUILDING. AUTOGENOUS WELDING. BRAZING AND SOLDERING. HEAT TREATMENT OF STEEL. LATEST TIMING PRACTICE. EIGHT AND TWELVE CYLINDER MOTORS, ETC., ETC. A GUIDE TO GREATER MECHANICAL EFFICIENCY FOR ALL REPAIRMEN. YOU WILL NEVER "GET STUCK" ON A JOB IF YOU OWN THIS BOOK. COMPLETE INDEX MAKES FOR EASY REFERENCE.

EVERY MOTORIST, DEALER, STUDENT, BLACKSMITH AND WHEELWRIGHT, DEMONSTRATOR, REPAIRMAN, CHAUFFEUR AND GARAGE OWNER WILL FIND THIS WORK OF REFERENCE INVALUABLE. MORE USEFUL THAN ANY OTHER TOOL IN THE MOTORIST'S KIT.

MUNN & COMPANY, Inc.

Woolworth Bldg., 233 Broadway, New York, N. Y.



Various, divergent, even capricious is the architecture of residences. A man builds his house to his individual taste or perchance to that of his architect. But modern business buildings are of standard types. Their architecture reflects the universal requirements of utility, convenience and service.

Motors, too, are designed either to suit an individual's taste or to meet universal requirements.

Of the manufacturers of motor cars and trucks in America, some still build their own motors. Each retains faith in his own genius or that of his designer; each naturally thinks his motor the best. But the variations are wide; few manufacturers accord to any other the sincere flattery of imitation. Their motors continue to reflect their personal preferences.

But more than one hundred and fifty manufacturers now use one or more models of the Continental Motor. Many of these formerly built their own motors. The combined experience of them all has been weighed, sifted, and summed up in the Continental Motor. Because it thoroughly satisfies the universal requirements of utility, convenience and service, it qualifies, without challenge, as America's standard motor.

CONTINENTAL MOTORS COMPANY

OFFICES: Detroit, Michigan
FACTORIES: Detroit, Muskegon

Largest exclusive motor manufacturers in the world.

Interesting Westerners

of this type are as rare as a dancing dinosaur. They have vanished with the settlement of the great Far West, supplanted by the earnest, law-abiding progressive westerners of today, who find neither time nor inclination to "shoot up" the atmosphere. You can make their acquaintance through the "Interesting Westerners" department of Sunset.

¶ There is much else of interest in every issue of this truly western magazine—timely editorial comment on current western topics; informative illustrated articles; lively western stories; beautiful color illustrations; interesting peeps into the Homes in the West; travel, development and economic articles.

¶ Sunset Magazine Service Bureau gives *free*, accurate information about the whole Pacific Slope country, its lands and resources, what to see, how to see it, where to stop, automobile highways, etc. It has helped thousands to know the West better, to see the West comfortably, to find homes. Perhaps we can help you.

Sunset

The National Magazine of the West

Get a copy from your Newsdealer, or use the introductory coupon.

"I-WANT-FREE-INFORMATION" COUPON—CLIP IT TODAY!

Sunset Magazine, San Francisco, California

I am interested in the Pacific Slope Country and want some information about (check) ☐Arizona ☐Farm Lands ☐Oregon ☐Auto Highways ☐California ☐Idaho ☐New Mexico ☐Nevada ☐Scenery ☐Colorado ☐Washington ☐Investments ☐Hotels and Resorts

An enclosing 10c for sample copy of Sunset Magazine.

Name .....

Address .....

S.A.9-16-16

THE BOOK OF A MILLION ANSWERS

The 3Cs (COMPREHENSIVE COMPACT CONVENIENT) Reference Library

Comprehensive

It contains about everything that Nature has created, the human mind has conceived, and man's ingenuity has devised. It spells, pronounces, and defines the *newest* as well as the oldest words in the English language.

It locates, and describes, every physical and political division, country, state, province, city, giving leading industries and populations according to latest census; every ocean, sea, gulf, bay, lake, strait, river, island, forest and mountain of importance. It gives the main facts in the history of every race, people, and dynasty; interesting accounts of religious beliefs, political parties, wars, revolutions, massacres, crusades, parliaments, legislative enactments; biographies of famous characters: popes, cardinals, reformers, leaders, teachers in ecclesiastical history; kings, queens, warriors, statesmen in ancient, medieval, and modern history; authors, artists, jurists, actors, dramatists, composers, singers, scientists, journalists, philanthropists, inventors, men of fashion and favorites of royalty.

EVERY SCIENCE, ART, MOVEMENT, THEORY, ACHIEVEMENT

It tells about the celestial bodies—planets, stars and constellations; and every living thing—animals, birds, fish, insects, trees, fruits and flowers. Describes the different orders of architecture, noted buildings and remains of past civilizations—palaces, cathedrals, prisons, tombs, highways; famous institutions—universities, colleges, libraries, museums. Divinities of Egyptian, Indian, Grecian, Roman and Norse mythology; orders of Knighthood and schools of philosophy; new religious sects, natural curiosities; inventions that have revolutionized modern industry; noted names and places in fiction—these are only a few of the *many hundred kinds* of information that might be enumerated did space permit,—embracing such subjects as electricity and other branches of physics, chemistry, mineralogy, geology, law and the practical arts—that are found in this marvelous storehouse of knowledge.

Compact

The foundation of every wisely selected Library for General Reference is an up-to-date Unabridged Dictionary. Without an Unabridged Dictionary the reader of "worth while books" and the current news is always at a disadvantage—he doesn't know the meaning of many of the words most important to the sense of the subject, especially the new scientific terms; consequently much of the benefit he would otherwise derive from his reading is lost.

The ideal Unabridged Dictionary is a dictionary in ONE volume, that can be consulted with the assurance that the word looked for is between its two covers, that is so light in weight that it needs no specially constructed stand, that is a pleasure in every way to use. Such is *Webster's Revised Unabridged Dictionary*, printed *on high grade Bible paper*, and—because it will be the most used book in The 3Cs Reference Library—bound in *Semi-Flexible*, rich *Full Leather*, and just *half the thickness* of the same book printed on ordinary book paper.

This volume and the 8 Volume Set of the New Edition of *The National Encyclopedia* (*Self Pronouncing*) that round out this ideal library occupy a space only *11½ inches long by 10¼ inches high*, making The 3Cs the most compact, as well as the most comprehensive, library in existence.

Convenient

Last, but not least, The 3Cs Reference Library is a model of convenience as regards the arrangement of its subject matter.

The divisions of the alphabet in the *Webster's Revised Unabridged Dictionary* are plainly indicated by the Patent Thumb Index. Hence the word you are looking for can be found without loss of time, or unnecessary turning of pages. Instant accessibility of contents is the Keynote of the arrangement of the whole library.

In the *National Encyclopedia* (*Self Pronouncing*), instead of grouping a number of subjects under one general heading—the way most other encyclopedias do, necessitating an index volume, or much tedious searching, to locate the particular information desired,—each subject or item is entered under its own name in proper alphabetical order, just where you would naturally look for it. With The 3Cs Library there is No "wondering where to look"! But exactly what you want, when you want it! And just enough too!

WEBSTER'S REVISED UNABRIDGED DICTIONARY

Published by the G. & C. MERRIAM COMPANY
For 70 years publishers of the Genuine Webster Dictionaries

The Standard of Authority Wherever the English Language is Spoken

Bound in Semi-Flexible Full Leather
Printed on High Grade Bible Paper. 2120 Pages.
Over 5,000 Illustrations
Colored Plates. Superb Half-Tone Pictures.

Thousands of New Words and Phrases.
Dictionary of Noted Names and Places in Fiction.
Pronouncing Gazetteer of over 25,000 Places.
Pronouncing Vocabulary of Greek and Latin Proper Names.
Dictionary of Classical and Foreign Quotations, Words and Phrases, Proverbs and Colloquial Expressions.
Table of the Metric System.
Arbitrary Signs, Abbreviations and Contractions.
Population Figures Based on The Latest Censuses.
Patent Thumb Index, Marble Edge.
Size 11½ x 9 x 2¼ inches—weight 7¼ lbs.

ONLY $1 SENT NOW

Brings You the Entire Library—

Webster's Revised Unabridged Dictionary and The National Encyclopedia

Nine volumes for less than the price of an unabridged dictionary

6,296 Pages
Over 6,000 Illustrations

and a whole year in which to pay the balance, if desired.

There will be hundreds who will embrace this opportunity. To avoid delay in the delivery of your order,

Be sure to send the dollar and coupon to-day. We prepay charges. Money back if not satisfied.

BRUNSWICK SUBSCRIPTION CO. S. A. 9-16-16
407 Brunswick Bldg., New York City

Enclosed find $1.00 first payment on The 3Cs Reference Library, 9 volumes. If as represented, I will keep the books and remit $1.00 a month for 12 months after their delivery. Otherwise, I will, within 5 days, ask for instructions for their return, at your expense, my $1.00 to be refunded on their receipt.

Name.....

Address.....

Occupation.....

Canada, duty and carriage extra

Every Self Respecting Home and Business Office Needs It

The young man or young woman who enters business or society with the idea they can "get by" on merely the knowledge picked up in school, and without constantly adding to that knowledge by reading and the liberal use of authoritative works of reference, won't go very far.

That's the big reason for such a large percentage of failures in life.

The people who have succeeded have realized when they went out into the world that what they learned at school was only the initial step; that to keep pace in the procession with those striving for the *high places* there must be *a continuous process of self education* by almost daily additions to the sum of general information—a new word or two added to the vocabulary, or a fact in history, literature, science, or the applied arts assimilated.

But such self education is impossible without an *Unabridged* Dictionary, like Webster's Revised, that is able to answer *all* your questions about words you don't understand, that tells you how to use and pronounce them, thereby enhancing your ability to express yourself with precision and force.

And without an up-to-date Encyclopedia, like the new National, how can you read with perfect understanding even the columns of the daily newspaper, to say nothing of the great works in literature?

ANSWERS ALL UP-TO-THE-MINUTE QUESTIONS

Such new words as *syndicalism, sabotage, auto-intoxication, post-impressionism, streamline, syncretism;* references to "Workmen's Compensation Act," "Pocket Veto," "New Thought," "Blue Sky Law," are constantly appearing in print—What do they mean? *Webster's Revised Unabridged* tells the meaning of these and thousands of other words and phrases of recent coinage.

The newspapers are full of the names of strange cities and provinces in the theater of the European War. We read of *Przemysl, Salonica, Czernowits, Volhynia, Croatia, Galicia, Bukowina, Mesopotamia*—Where are they and what kind of people live there?

There are daily paragraphs about Albania, Montenegro, Serbia, Bulgaria—these countries have tragic histories:—Do you know them?

Why were the Russians so anxious to take Erzerum, and why do the Cossacks pay no taxes to the Czar?

The new *National Encyclopedia* answers all these questions and hundreds of others like them that will add to your interest in and understanding of what is going on in Europe. The National Encyclopedia is Self Pronouncing. With it to consult even *Przemysl* loses its terrors.

THE NATIONAL ENCYCLOPEDIA *Self Pronouncing*)

Edited by Encyclopedic Authorities of America and England. *Designed to meet the requirements of the American home, school and office. Treats all subjects with clarity and conciseness.*

Eight Volumes, Each 8½ x 7½ Inches 4,176 Double-Column Pages.
Over 1000 Half Tone and Text Illustrations. Frontispieces Printed in Color.
Bound in Durable Basket Weave Cloth with Leather Label Stamped in Gold.